

**URS OPERATING SERVICES, INC.
START2 - REGION VIII**

MEMORANDUM



TO: Joyce Ackerman, OSC Region VIII EPA (8EPR-ER)

FROM: Randy Perlis, Senior Project Manager

DATE: August 9, 2001

SUBJECT: **START2, EPA Region VIII, Contract No. 68-W-00-118, TDD No. 0105-0008**
Methylene Chloride Information, DefTech Tear Gas Site, Casper, WY

Please find attached everything you ever wanted to know about methylene chloride. I have highlighted the human health effects. As you will see, methylene chloride is not considered to be very toxic and is used extensively in industry. The TLV is 50 ppm. I doubt that anyone outside of the building where the solvent is used would come close to this concentration. Methylene chloride is highly volatile with a boiling point of 104°F and a vapor pressure of 349 mmHg @ 20°C (1 atmosphere at sea level equals 760 mmHg), therefore it would not persist long in an outdoor environment.

ENC: Methylene Chloride Information

METHYLENE CHLORIDE

HAZARDTEXT(R) - Hazard Management

1.0 IDENTIFICATION

1.1 SYNONYMS

AEROTHENE MM
CHLORURE DE METHYLENE (French)
DCM
DICHLOROMETHANE
F 30
FREON 30
HCC 30
KHLADON
MDC
METHANE DICHLORIDE
METHANE, DICHLORO-
METHYLENE BICHLORIDE
METHYLENE CHLORIDE
METHYLENE DICHLORIDE
METHYLENUM CHLORATUM
METYLENU CHLOREK (Polish)
NARKOTIL
R 30
SOLAESTHIN
SOLEANA VDA
SOLMETHINE

1.2 IDENTIFIERS

1.2.1 CAS REGISTRY NUMBER:

CAS 75-09-2

1.2.2 NIOSH/RTECS NUMBER:

NIOSH/RTECS PA 8050000

1.2.3 UN/NA NUMBER:

1593 - Methylene chloride
1593 - Dichloromethane
1912 - Methyl chloride-methylene chloride mixture

1.2.4 STCC NUMBER:

STCC 49 411 32 - Methylene chloride
STCC 49 411 32 - Dichloromethane
STCC 49 057 64 - Methyl chloride-methylene chloride mixture

1.2.5 DESIGNATIONS:

NCI-c 50102
OHM/TADS NUMBER: 7217234
RCRA WASTE NUMBER: U080
WISWESSER NOTATION: G1G
Bielstein reference number: 4-01-00-00035
BRN: 1730800
SIC code: 2821

1.2.6 MOLECULAR FORMULA:

CH₂Cl₂
ClCH₂Cl

1.2.7 ERG2000 GUIDE NUMBER:

160 - HALOGENATED SOLVENTS (UN/NA 1593)

1.3 SYNONYM REFERENCE

A. Ashford, 1994; HSDB, 1998; RTECS, 1998

1.4 USES/FORMS/SOURCES

A. FORMS

1. Methylene chloride is a colorless, volatile, nearly nonflammable liquid (Budavari, 1996; Lewis, 1996; AAR, 1998).

B. SOURCES

1. It is produced by the chlorination of methyl chloride followed by distillation, by thermal chlorination (methyl chloride + chlorine), by Lummus oxychlorination (natural gas + hydrogen chloride), or by oxychlorination (natural gas + anhydrous hydrogen chloride) (Ashford, 1994; Lewis, 1997).

C. USES

1. Methylene chloride is used mainly as a solvent. It is used in cellulose acetate/triacetate and butyl rubber production; in degreasing and cleaning fluids; as a solvent in food processing; as a pharmaceutical aid (solvent); in paint removers; in plastics processing; as a blowing agent (in polyurethane foams); in solvent extraction; in aerosol propellants; in the manufacture of photographic film; to decaffeinate coffee; in refrigeration; as an insecticide (fumigant); and in many other applications for which a "non-flammable" solvent is required (ACGIH, 1991; Ashford, 1994; Budavari, 1996; Lewis, 1997; ITI, 1995; Clayton & Clayton, 1994).
2. In the 1920s, methylene chloride was used in Germany as a general anesthetic. This clinical use was soon discontinued because of various adverse reactions including death (Manno et al, 1992). The compound is still used in Europe as a local anesthetic agent (OHM/TADS, 2000).

3.0 CLINICAL EFFECTS

3.1 GENERAL CLINICAL EFFECTS

A. Methylene chloride may be absorbed after inhalation, ingestion, or dermal exposure. Acute

exposure causes mucous membrane and respiratory tract irritation and narcotic effects, and, at high concentrations, central nervous system (CNS) depression and respiratory failure. Dermal contact may cause irritation and burns.

1. There are few reports of injury despite widespread use. Solvent abuse has resulted in deaths.
 2. In humans exposed by ingestion or inhalation, paresthesias, somnolence, altered sleep patterns, convulsions, euphoria, and change in cardiac rate may occur. Ingestion may also produce gastrointestinal burns, hemorrhage, and necrosis.
 3. The central nervous system is the primary target of methylene chloride exposure. Once absorbed, the major sites of distribution are the liver, brain, and adipose tissue.
- B. Methylene chloride is metabolized in part to carbon monoxide and may cause elevations in carboxyhemoglobin, rarely as high as 50 percent in severe exposures. Physical exertion increases absorption, conversion to carbon monoxide and carboxyhemoglobin levels.
- C. Combustion of methylene chloride or use around open flames or heated surfaces may evolve hydrogen chloride, phosgene, and chlorine.
- D. Concentrations in excess of 50,000 ppm are thought to be immediately life-threatening.
- E. **ERG2000 INFORMATION**
1. **HEALTH HAZARDS - ERG2000 (HALOGENATED SOLVENTS) - GUIDE 160**
 - a. Vapors may cause dizziness or suffocation.
 - b. Exposure in an enclosed area may be very harmful.
 - c. Contact may irritate or burn skin and eyes.
 - d. Fire may produce irritating and/or toxic gases.
 - e. Runoff from fire control or dilution water may cause pollution.
 - f. Reference: ERG, 2000.

3.2 ACUTE CLINICAL EFFECTS

- A. Methylene chloride is moderately toxic by ingestion,, inhalation, subcutaneous, and intraperitoneal routes. Most occupational exposures are by inhalation; concentrations in excess of 50,000 ppm are thought to be immediately life-threatening (Hathaway et al, 1996; Lewis, 1996).
- B. Absorption occurs readily through the lungs (Raffle et al, 1994). Although methylene chloride can be absorbed through the skin sufficiently to cause systemic symptoms, chlorinated hydrocarbons are considered to be poorly absorbed through the skin (Zenz, 1994; Harbison, 1998). Methylene chloride is also absorbed rapidly and well after ingestion (US DHHS, 1991).
- C. There are few reports of injury despite widespread use (ACGIH, 1991). Solvent abuse has led to death (Harbison, 1998).
- D. The toxic effects of methylene chloride exposure are related in part to its conversion to CARBON MONOXIDE by the liver, which yields increased concentrations of carboxyhemoglobin in the blood (Clayton & Clayton, 1994; Harbison, 1998; Morgan, 1993; Baselt, 1997). However, the concentrations are usually not high enough to produce symptoms of carbon monoxide poisoning (Morgan, 1993).
- E. The main acute effect of methylene chloride is central nervous system depression (Clayton & Clayton, 1994). Its central nervous system depression and narcotic effects have reportedly produced fatalities (Baselt, 1997).
1. Exposure to methylene chloride causes a panoply of neurologic symptoms, including headache, giddiness, lightheadedness, dizziness, euphoria, irritability, loss of appetite, sleepiness, weakness, fatigue, stupor, convulsions, numbness, anesthesia and limb tingling (ILO, 1998; ACGIH, 1991; Baselt, 1997; Budavari, 1996).
 2. The neurotoxicity is thought to be due both to a direct nonspecific central nervous

system depressant action of methylene chloride and also to indirect effects of carbon monoxide (Wineke, 1981). Methylene chloride may exert its acute effects on the nervous system by mechanisms related to its lipophilicity, which allows it to pass through the blood-brain barrier. It may have a direct inhibitory action on nerve conduction at the nerve cell membrane. Induction of carboxyhemoglobin leads to a reduced oxygen-carrying capacity of the blood, thus adding to the potential neurotoxic effects (Von Burg, 1995).

- F. Exposure to methylene chloride can cause occupational heart disease, including coronary atherosclerosis, arrhythmias, myopathy, myocardial ischemia and infarction (Clayton & Clayton, 1994; ILO, 1998; Harbison, 1998). Prolonged exposure can result in shortness of breath, cough (with pain) and possible pulmonary edema, as well as respiratory depression; death from respiratory insufficiency (ILO, 1998; Lewis 1998). Respiratory failure may develop secondary to central nervous system depression in severe exposures (Manno et al, 1990; Chang et al, 1999).
- G. Methylene chloride also produces irritant conjunctivitis and lacrimation (Hathaway et al, 1996). Contact with liquid methylene chloride produces pain, skin irritation, and burns if the liquid is not removed (ACGIH, 1991). The skin irritation is accentuated if the chemical is 'sealed' to the skin by shoes or tight clothing, and is most severe with paint remover formulations that form a 'skin' or film (Clayton & Clayton, 1994).
- H. The phosgene released when methylene chloride is oxidized by an open flame also produces toxic effects (Baselt, 1997).

3.3 CHRONIC CLINICAL EFFECTS

- A. Epidemiologic studies on the chronic effects of methylene chloride exposure have not demonstrated any association with increased cancer risk or chronic neurotoxicity nor any other specific cause of death or chronic illness (Harbison, 1998).
- B. Chronic exposure to methylene chloride has produced headaches, dizziness, nausea, loss of memory, tingling in the hands and feet, and loss of consciousness. Many of these effects can be correlated with carboxyhemoglobin levels (Von Burg, 1995).
- C. Chronic methylene chloride exposure has been reported to result in kidney damage (Miller et al, 1985). Chronic methylene chloride exposure at airborne levels of 300 to 1,000 ppm has been associated with loss of memory and balance disturbances (Barrowcliff & Knell, 1979). Nervous system disorders were reported in 30 percent of workers chronically exposed to airborne levels of 6.3 to 33.9 mg/m³ (maximum of only 9 ppm) (Kashin et al, 1980).
- D. A Czech study reported neurological complaints in workers exposed to methylene chloride airborne levels of 500 ppm or less (Kuzelova et al, 1982). Learning disabilities were found in mice exposed to 168 mg/L (approximately 40,000 ppm) by inhalation (Aleksieff & Kilgore, 1983).
- E. Methylene chloride has been reported to affect the heart with chronic exposure, producing changes in the ECG pattern (Davidson et al, 1983).
- F. An epidemiological study of persons exposed to methylene chloride and other toxic solvents (particularly carbon disulfide) found an increase in ischemic heart disease (Wilcosky & Tyroler, 1983).
- G. A large epidemiological study found NO increased risk of ischemic heart disease in workers chronically exposed to 140 to 475 ppm methylene chloride (Ott et al, 1983). In an update of an ongoing study, no excess deaths from cardiovascular disease were found in a group of cellulose fiber production workers exposed to a median range of 140 to 745 ppm of methylene chloride from 1977 to 1990 (Lanes et al, 1993).
- H. A proportionate mortality study found no increase in deaths from malignant neoplasms among

workers exposed for up to 30 years to mean concentrations of methylene chloride ranging from 33 to 118.8 ppm compared with control populations (HSDB, 2000).

- I. In subchronic studies in experimental animals, methylene chloride was readily absorbed through intact skin in rats exposed for 4 months; it accumulated in skin and body fat (McKenna et al, 1982). The highest no-effect level in dogs exposed to methylene chloride by inhalation for 90 days was 5,000 ppm; and the lowest toxic dose in rats was 10,000 ppm (Leushner et al, 1984).

4.0 FIRST AID

4.2 FIRST AID AND PREHOSPITAL TREATMENT

A. EMESIS/NOT RECOMMENDED -

1. Emesis is not recommended because of the potential for CNS depression and seizures.

B. ACTIVATED CHARCOAL -

1. PREHOSPITAL ACTIVATED CHARCOAL ADMINISTRATION

- a. Consider prehospital administration of activated charcoal as an aqueous slurry in patients who are awake and able to protect their airway. Activated charcoal is most effective when administered within one hour of ingestion.
 1. In patients who are at risk for the abrupt onset of seizures or mental status depression, activated charcoal should be administered by medical or paramedical personnel capable of airway management to prevent aspiration in the event of spontaneous emesis.

2. CHARCOAL DOSE

- a. Use a minimum of 240 milliliters of diluent per 30 grams charcoal (FDA, 1985). Optimum dose not established; usual dose is 25 to 100 grams in adults and adolescents; 25 to 50 grams in children aged 1 to 12 years; and 1 gram/kilogram in infants up to 1 year old (Anon, 1997).

3. ADVERSE EFFECTS/CONTRAINDICATIONS

- a. Complications: emesis, aspiration, corneal abrasions (Anon, 1997). Refer to the ACTIVATED CHARCOAL/TREATMENT management for further information.
- b. Contraindications: unprotected airway, gastrointestinal tract not anatomically intact, therapy may increase the risk or severity of aspiration; ingestion of most hydrocarbons (Anon, 1997).

5.0 MEDICAL TREATMENT

5.1 LIFE SUPPORT

- A. Support respiratory and cardiovascular function.

5.2 SUMMARY

A. ERG2000 INFORMATION -

1. FIRST AID - ERG2000 (HALOGENATED SOLVENTS) - GUIDE 160

- a. Move victim to fresh air.
- b. Call 911 or emergency medical care.
- c. Apply artificial respiration if victim is not breathing.
- d. Administer oxygen if breathing is difficult.

- e. Remove and isolate contaminated clothing and shoes.
- f. In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- g. For minor skin contact, avoid spreading material on unaffected skin.
- h. Wash skin with soap and water.
- i. Keep victim warm and quiet.
- j. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.
- k. Reference: ERG, 2000.

B. FIRST AID (NIOSH, 1998) -

1. **EYE EXPOSURE** - If this chemical contacts the eyes, immediately wash the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.
2. **DERMAL EXPOSURE** - If this chemical contacts the skin, promptly wash the contaminated skin with soap and water. If this chemical penetrates the clothing, promptly remove the clothing and wash the skin with soap and water. Get medical attention promptly.
3. **INHALATION EXPOSURE** - If a person breathes large amounts of this chemical, move the exposed person to fresh air at once. If breathing has stopped, perform mouth-to-mouth resuscitation. Keep the affected person warm and at rest. Get medical attention as soon as possible.
4. **ORAL EXPOSURE** - If this chemical has been swallowed, get medical attention immediately.
5. **TARGET ORGANS** - Eyes, skin, cardiovascular system, and CNS.

C. GENERAL -

1. Move victims of inhalation exposure from the toxic environment and administer 100% humidified supplemental oxygen with assisted ventilation as required. Exposed skin and eyes should be copiously flushed with water. Because of the potential for rapid onset of CNS depression or seizures with possible aspiration of gastric contents, **EMESIS SHOULD NOT BE INDUCED**. Cautious gastric lavage followed by administration of activated charcoal may be of benefit if the patient is seen soon after the exposure.

D. INHALATION EXPOSURE -

1. **DECONTAMINATION**: Move patient to fresh air. Monitor for respiratory distress. If cough or difficulty in breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. Administer 100 percent humidified supplemental oxygen with assisted ventilation as required.
2. If bronchospasm and wheezing occur, consider treatment with inhaled sympathomimetic agents.
3. **SEIZURES**: Administer a benzodiazepine IV; **DIAZEPAM** (ADULT: 5 to 10 mg, repeat every 10 to 15 minutes as needed. CHILD: 0.2 to 0.5 mg/kg, repeat every 5 minutes as needed) or **LORAZEPAM** (ADULT: 4 to 8 mg; CHILD: 0.05 to 0.1 mg/kg).
 - a. Consider phenobarbital and/or phenytoin or fosphenytoin if seizures are uncontrollable or recur after diazepam 30 mg (adults) or 10 mg (children > 5 years).
 - b. Monitor for hypotension, dysrhythmias, respiratory depression and the need for endotracheal intubation.
 - c. Evaluate for hypoglycemia, electrolyte disturbances, and hypoxia.
4. Administer oxygen and determine carboxyhemoglobin concentration in patients with systemic symptoms.

E. DERMAL EXPOSURE -

1. **DECONTAMINATION:** Wash exposed area extremely thoroughly with soap and water. A physician may need to examine the area if irritation or pain persists.
2. Treat dermal irritation or burns with standard topical therapy. Patients developing dermal hypersensitivity reactions may require treatment with systemic or topical corticosteroids or antihistamines. Administer oxygen and determine carboxyhemoglobin concentration in patients with systemic symptoms.

F. EYE EXPOSURE -

1. **DECONTAMINATION:** Exposed eyes should be irrigated with copious amounts of tepid water for at least 15 minutes. If irritation, pain, swelling, lacrimation, or photophobia persist, the patient should be seen in a health care facility.

G. ORAL EXPOSURE -

1. Because of the potential for gastrointestinal tract irritation or CNS depression, **DO NOT** induce emesis.
2. Significant esophageal or gastrointestinal tract irritation or burns may occur following ingestion. The possible benefit of early removal of some ingested material by cautious gastric lavage must be weighed against potential complications of bleeding or perforation.
3. **GASTRIC LAVAGE:** Consider after ingestion of a potentially life-threatening amount of poison if it can be performed soon after ingestion (generally within 1 hour). Protect airway by placement in Trendelenburg and left lateral decubitus position or by endotracheal intubation. Control any seizures first.
 - a. **CONTRAINDICATIONS:** Loss of airway protective reflexes or decreased level of consciousness in unintubated patients; following ingestion of corrosives; hydrocarbons (high aspiration potential); patients at risk of hemorrhage or gastrointestinal perforation; and trivial or non-toxic ingestion.
4. **ACTIVATED CHARCOAL/CATHARTIC:** Administer charcoal slurry, aqueous or mixed with saline cathartic or sorbitol. The FDA suggests 240 mL of diluent/30 g of charcoal. Usual charcoal dose is 25 to 100 grams in adults and adolescents, 25 to 50 grams in children (1 to 12 years old), and 1 gram/kilogram in infants less than 1 year old.
 - a. Routine use of cathartics is **NOT** recommended. If used, administer only **ONE** dose of cathartic. Administer one dose of a cathartic, mixed with charcoal or given separately. See "Treatment: Prevention of Absorption in the main document.
5. **SEIZURES:** Administer a benzodiazepine IV; **DIAZEPAM** (ADULT: 5 to 10 mg, repeat every 10 to 15 minutes as needed. **CHILD:** 0.2 to 0.5 mg/kg, repeat every 5 minutes as needed) or **LORAZEPAM** (ADULT: 4 to 8 mg; **CHILD:** 0.05 to 0.1 mg/kg).
 - a. Consider phenobarbital and/or phenytoin or fosphenytoin if seizures are uncontrollable or recur after diazepam 30 mg (adults) or 10 mg (children > 5 years).
 - b. Monitor for hypotension, dysrhythmias, respiratory depression and the need for endotracheal intubation.
 - c. Evaluate for hypoglycemia, electrolyte disturbances, and hypoxia.

- H. Administer oxygen and determine carboxyhemoglobin concentration in patients with systemic symptoms.

6.0 RANGE OF TOXICITY**6.1 MINIMUM LETHAL EXPOSURE**

- A. Methylene chloride is moderately toxic by ingestion, subcutaneous, and intraperitoneal routes,

and mildly toxic by inhalation. Most occupational exposures are by inhalation; concentrations in excess of 50,000 ppm are thought to be immediately life-threatening (Hathaway et al, 1996; Lewis, 1996).

- B. An LDLo (lowest dose reported to cause death) of 375 mg/kg (oral) has been reported for humans (Lewis, 1996).
- C. The toxic effects of methylene chloride exposure are related in part to its conversion to carbon monoxide, which yields increased concentrations of carboxyhemoglobin in the blood (Morgan, 1993; Baselt, 1997). The phosgene released when methylene chloride is oxidized by an open flame also produces toxic effects (Baselt, 1997).

6.2 MAXIMUM TOLERATED EXPOSURE

- A. In human experiments, inhalation of 500 to 1,000 ppm for 1 or 2 hours resulted in light-headedness; there was sustained elevation of carboxyhemoglobin level in each of 11 non-smoking subjects (Hathaway et al, 1996).
- B. No effects were seen in volunteers exposed to 250 ppm for up to 7.5 hours/day, 5 days/week for 2 weeks, or when male subjects were exposed to 500 ppm on 2 consecutive days. An excess in self-reported neurologic symptoms was found in workers repeatedly exposed to 75 to 100 ppm, although no significant deleterious effects were observed on clinical examination (ACGIH, 1991; Hathaway et al, 1996).
- C. Complaints of headache, fatigue, and irritation of the eyes and respiratory passages were reported by workers exposed to concentrations up to 5,000 ppm. Neurasthenic disorders were found in 50 percent and digestive disturbances in 30 percent of these workers (ACGIH, 1991).
- D. After one year of exposure, a chemist developed toxic encephalopathy with acoustical and optical delusions and hallucinations. Concentrations frequently exceeded 500 ppm of methylene chloride; levels of 660 ppm, 800 ppm and, near the floor, 3,600 ppm were noted (ACGIH, 1991; Hathaway et al, 1996).

6.3 TOXICITY VALUES

- A. References: Lewis, 1996; RTECS, 2000

TCLo - (INHL) HUMAN: 500 ppm for 1Y-I
 TCLo - (INHL) HUMAN: 500 ppm for 8H
 TCLo - (INHL) RAT, Female: 4500 ppm for 24H --
 1-17D preg
 TCLo - (INHL) RAT: 3500 ppm for 6H/2Y-I
 TCLo - (INHL) RAT: 500 ppm for 6H/2Y
 TCLo - (INHL) MOUSE: 2000 ppm for 5H/2Y-C
 TCLo - (INHL) MOUSE, Female: 1250 ppm for 7H --
 6-15D preg
 LCLo - (INHL) RABBIT: 10,000 ppm for 7H
 LCLo - (INHL) GUINEA PIG: 5000 ppm for 2H
 LCLo - (INHL) DOG: 14,108 ppm for 7H
 LCLo - (INHL) CAT: 43,400 mg/m(3) for 4.5H
 LDLo - (ORAL) HUMAN: 357 mg/kg
 LDLo - (IT) RAT: 350 mg/kg
 LDLo - (ORAL) RABBIT: 1900 mg/kg
 LDLo - (SC) RABBIT: 2700 mg/kg
 LDLo - (ORAL) DOG: 3 g/kg
 LDLo - (IP) DOG: 950 mg/kg
 LDLo - (IV) DOG: 200 mg/kg
 LDLo - (SC) DOG: 2700 mg/kg
 LC50 - (INHL) RAT: 52 g/m(3)
 LC50 - (INHL) RAT: 88,000 mg/m(3) for 30M

LC50 - (INHL) MOUSE: 14,400 ppm for 7H
LD50 - (ORAL) RAT: 1600 mg/kg
LD50 - (IP) RAT: 916 mg/kg
LD50 - (UNREPORTED) RAT: 5350 mg/kg
LD50 - (IP) MOUSE: 437 mg/kg
LD50 - (SC) MOUSE: 6460 mg/kg
LD50 - (UNREPORTED) MOUSE: 4770 mg/kg
LD50 - (UNREPORTED) RABBIT: 1225 mg/kg
LD50 - (INHL) DOG: 1274 mg/kg

6.4 CALCULATIONS

A. CONVERSION FACTORS

- 1 ppm = 3.53 mg/m(3) (ACGIH, 1991; ATSDR, 1993)
- 1 ppm = 3.48 mg/m(3) (at 25 degrees C and 760 mmHg) (Clayton & Clayton, 1994)
- 1 mg/m(3) = 0.28 ppm (ATSDR, 1993)
- 1 mg/L = 288 ppm (at 25 degrees C and 760 mmHg) (Clayton & Clayton, 1994)

7.0 STANDARDS AND LABELS

7.1 WORKPLACE STANDARDS

A. ACGIH-TLV: 50 ppm TWA; no STEL (ACGIH, 2000)

1. Notation(s):
 - a. Skin Notation: Not Listed
 - b. Carcinogenicity: Confirmed Animal Carcinogen with Unknown Relevance to Humans
2. Molecular weight: 84.93
 - a. To convert the TLV from ppm to mg/m(3): (TLV ppm) (gram molecular weight of substance)/24.45 To convert the TLV from mg/m(3) to ppm: (TLV in mg/m(3)) (24.45)/gram molecular weight of substance
3. TLV Basis - Critical Effect(s): CNS; anoxia

B. OSHA PEL: Listed (OSHA, 1999b)

1. Limit(s) for Air Contaminant (Table Z-1): Listed See Table Z-2
2. Limit(s) for Air Contaminant (Table Z-2): Listed
 - a. 8-Hour Time Weighted Average: 25 ppm
 - b. Acceptable Ceiling Concentration: Not Listed
 - c. Acceptable Maximum Peak above the Acceptable Ceiling Concentration for an 8-hour shift:
 1. Concentration: 125 ppm
 2. Maximum Duration: 15-minute TWA
 - d. Notes: OSHA has set an "action level" of 12.5 ppm, measured as an 8-hour TWA.
3. Limit(s) for Air Contaminant (Table Z-3): Not Listed

C. OSHA List of Highly Hazardous Chemicals, Toxics and Reactives: Not Listed (OSHA, 1999a)

D. NIOSH VALUES: (NIOSH, 2000)

1. REL: Refer to Appendix A in the NIOSH Pocket Guide(TM) on TOMES Plus(R) for more information.
 - a. Skin Notation: Not Listed
2. IDLH VALUE: 2300 ppm
 - a. NIOSH considers this substance to be a potential occupational carcinogen.

E. AIHA WEEL VALUE: Not Listed (AIHA, 2000)

7.2 ENVIRONMENTAL STANDARDS

A. SARA TITLE III

1. EHS (EXTREMELY HAZARDOUS SUBSTANCES) LIST: Not Listed (EPA, 1999g)
2. SECTION 313: Listed (EPA, 1999h)
 - a. Effective Date: 1/1/87

B. CERCLA; HAZARDOUS SUBSTANCES and REPORTABLE QUANTITIES: Listed (EPA, 1999f)

1. Statutory RQ (Reportable Quantity):
 - a. 1* pound - (1* Indicates that the 1-pound RQ is a CERCLA statutory RQ).
 - b. Codes: Listed
 1. 2 - Indicates that the statutory source for designation of this hazardous substance under CERCLA is CWA Section 307(a). 3 - Indicates that the statutory source for designation of this hazardous substance under CERCLA is CAA Section 112. 4 - Indicates that the statutory source for designation of this hazardous substance under CERCLA is RCRA Section 3001.
2. Final RQ (Reportable Quantity):
 - a. 1000 pounds (454 kilograms)
 - b. Notes: Not Listed
 - c. Final RQ Category: C

C. RCRA HAZARDOUS WASTE NUMBER: Listed (EPA, 1999; EPA, 1999b; EPA, 1999c; EPA, 1999e)

1. waste number U080 Included in waste streams: F001, F002, F024, F025, F039, K009, K010, K156, K157, K158

D. TSCA INVENTORY: Listed (LOLI, 2000)

E. AIHA ERPG VALUES: Listed (AIHA, 2000)

1. ERPG-1: 200 ppm
 - a. The ERPG-1 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.
2. ERPG-2: 750 ppm
 - a. The ERPG-2 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.
3. ERPG-3: 4000 ppm
 - a. The ERPG-3 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

F. DOT List of Marine Pollutants: Not Listed (DOT, 1999)

7.3 SHIPPING REGULATIONS

7.3.1 SURFACE

A. Table of Hazardous Materials and Special Provisions: Listed (DOT, 1997)

1. Hazardous materials descriptions and proper shipping name: DICHLOROMETHANE
 - a. Symbol(s): Not Listed

2. Hazard class or Division: 6.1 6.1: Poisonous materials
3. Identification Numbers: UN1593
4. Packing group: III
5. Label(s) required (if not excepted): KEEP AWAY FROM FOOD
6. Special provisions: N36, T13 N36: Aluminum or aluminum alloy construction materials are permitted only for halogenated hydrocarbons that will not react with aluminum. T13: IM tank type: 101 Minimum test pressure (bars): 4 Bottom outlets: see section 173.32c (g)(1) Pressure relief devices: see section 178.270-11(a)(1),(2)
7. Packaging authorizations:
 - a. Exceptions: refer to section 173.153
 - b. Non-bulk packaging: refer to section 173.203
 - c. Bulk packaging: refer to section 173.241
8. Quantity limitations:
 - a. Passenger aircraft or railcar: 60 L
 - b. Cargo Aircraft only: 220 L
9. Vessel stowage requirements:
 - a. Vessel stowage: A A: Stowage category "A" means the material may be stowed "on deck" or "under deck" on a cargo vessel and on a passenger vessel.
 - b. Other stowage provisions: Not Listed

7.3.2 AIR

A. INTERNATIONAL (IATA, 1997)

1. UN 1593
2. PROPER SHIPPING NAME: Dichloromethane
3. CLASS OR DIVISION NUMBER: 6.1
4. SUBSIDIARY RISK CLASS OR DIVISION NUMBER: Not Listed
5. PRIMARY HAZARD LABEL: Toxic
6. SUBSIDIARY RISK HAZARD LABEL: Not Listed
7. UN PACKING GROUP NUMBER: III
8. PASSENGER AIRCRAFT
 - a. PACKING INSTRUCTION NUMBER: 605
 - b. LIMITED QUANTITY PACKAGING INSTRUCTION NUMBER: Y605
 - c. MAXIMUM NET QUANTITY PER PACKAGE: 60 L
 - d. LIMITED QUANTITY PACKAGING MAXIMUM NET QUANTITY PER PACKAGE: 2 L
9. CARGO AIRCRAFT
 - a. PACKING INSTRUCTION NUMBER: 612
 - b. MAXIMUM NET QUANTITY PER PACKAGE: 220 L

7.4 LABELS

7.4.4 NFPA

A. NFPA HAZARD RATINGS

1. HEALTH (BLUE): 2
 - a. Materials that, on intense or short exposure, could cause temporary incapacitation or possible residual injury, including those requiring the use of respiratory protective equipment that has an independent air supply (NFPA, 1994).
2. FLAMMABILITY (RED): 1

- a. Materials that must be preheated before ignition can occur. Materials in this degree require considerable preheating, under all ambient temperature conditions, before ignition and combustion occur (NFPA, 1994).
- 3. REACTIVITY/INSTABILITY (YELLOW): 0
 - a. Materials that in themselves are normally stable, even under fire conditions (NFPA, 1994).

7.5 OTHER

- A. From 40 CFR 60.489 (7/1/99): "This action promulgates standards of performance for equipment leaks of Volatile Organic Compounds (VOC) in the Synthetic Organic Chemical Manufacturing Industry (SOCMI). The intended effect of these standards is to require all newly constructed, modified, and reconstructed SOCMI process units to use the best demonstrated system of continuous emission reduction for equipment leaks of VOC, considering costs, non air quality health and environmental impact and energy requirements. Methylene chloride is produced, as an intermediate or final product, by process units covered under this subpart." (HSDB, 2000)
- B. FIFRA Requirements
 - 1. From 40 CFR 180.1001(d) (7/1/99): "Dichloromethane is exempted from the requirement of a tolerance when used as a solvent or cosolvent in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops only." (HSDB, 2000)
 - 2. From EPA 738-R-98-002 (Spring, 1998): "As the federal pesticide law FIFRA directs, EPA is conducting a comprehensive review of older pesticides to consider their health and environmental effects and make decisions about their future use. Under this pesticide reregistration program, EPA examines health and safety data for pesticide active ingredients initially registered before November 1, 1984, and determines whether they are eligible for reregistration. In addition, all pesticides must meet the new safety standard of the Food Quality Protection Act of 1996. Pesticides for which EPA had not issued Registration Standards prior to the effective date of FIFRA, as amended in 1988, were divided into three lists based upon their potential for human exposure and other factors, with List B containing pesticides of greater concern and List D pesticides of less concern. Methylene chloride is found on List C. Case No: 3090; Pesticide type: insecticide; Case Status: No products containing the pesticide are actively registered ... The case is characterized as "cancelled." Under FIFRA, pesticide producers may voluntarily cancel their registered products. EPA also may cancel pesticide registrations if registrants fail to pay required fees or make/meet certain reregistration commitments, or if EPA reaches findings of unreasonable adverse effects.; Active ingredient (AI): Methylene chloride; AI Status: The active ingredient is no longer contained in any registered pesticide products ... "cancelled." (HSDB, 2000)
- C. Federal Drinking Water Standard (From the US EPA): 5 mcg/L (HSDB, 2000)
- D. State Drinking Water Standard(s) (HSDB, 2000)

New Jersey: 2 mcg/L

E. State Drinking Water Guidelines (HSDB, 2000)

Arizona: 4.7 mcg/L
 Connecticut: 25 mcg/L
 Maine: 48 mcg/L
 Minnesota: 50 mcg/L

F. MSHA STANDARD (Air): 500 ppm (1750 mg/m(3)) TWA (RTECS, 2000)

8.0 HANDLING AND STORAGE

8.1 SUMMARY

- A. Methylene chloride is toxic, an irritant and narcotic, and a suspected human carcinogen. Avoid breathing vapors and skin contact; use appropriate chemical-protective clothing and eye protection and a positive-pressure self-contained breathing apparatus (AAR, 1998; Lewis, 1997; Sittig, 1991).

8.2 HANDLING

- A. Methylene chloride is, generally, stable during transport (in the absence of moisture and at "ordinary temperatures") (CHRIS, 1998; HSDB, 1998).
- B. Requires an inert atmosphere for shipping (CHRIS, 1998).
- C. "When truckload or carload of drums is recieved, the doors should be opened to allow thorough ventilation before the truck or car is entered." (OHM/TADS, 1998)
- D. Persons handling this compound should wear chemical goggles, rubber protective clothing (gloves and boots), and an airline respirator (AAR, 1994; ITI, 1988).

8.3 STORAGE

8.3.1 CONTAINER

- A. Store in a tightly closed container; typical shipping containers include glass bottles, steel drums, tanks on trucks, rail cars, and barges (NFPA, 1994; Sittig, 1991).
- B. To minimize decomposition, methylene chloride storage containers should be lined with a phenolic or galvanized coating (HSDB, 1998).

8.3.2 ROOM/CABINET RECOMMENDATIONS

- A. Store in a cool, dry, well-ventilated location Isolate from active metals and high heat sources (ITI, 1988; NFPA, 1994; Sittig, 1991).
- B. To prevent vapors from escaping into work areas, indoor storage tanks need to have vents piped outdoors (OHM/TADS, 1998).
- C. Do not utilize rubber or plastic hoses for unloading trucks, tank cars, etc, unless the specific material(s) have been tested and approved for methylene chloride service (OHM/TADS, 1998).

8.3.3 INCOMPATIBILITIES

- A. Methylene chloride is incompatible with active metals and sources of high heat (ITI, 1988; NFPA, 1994; Sittig, 1991).
- B. Isolate methylene chloride from active metals, strong caustics, and strong oxidizers (HSDB, 1998; NFPA, 1994).
- C. Keep separate from any possible ignition sources (ITI, 1988).
- D. Moist air should be prevented from entering tanks/containers (OHM/TADS, 1998).

9.0 PERSONAL PROTECTION

9.1 SUMMARY

- A. PROTECTIVE CLOTHING - ERG2000 (HALOGENATED SOLVENTS) - GUIDE 160
 - 1. Wear positive pressure self-contained breathing apparatus (SCBA).
 - 2. Structural firefighters' protective clothing will only provide limited protection.
 - 3. Reference: ERG, 2000.
- B. Appropriate protective clothing should be worn to prevent skin contact with the vapor or liquid. Wash the skin, with large amounts of soap and water, immediately after it becomes contaminated. Clothing which becomes wet should be removed as quickly as possible. There is no specific recommendation for workers to change clothing before leaving the job site (AAR, 1994; NFPA, 1994; Sittig, 1991).
- C. Emergency responders should wear full protective clothing in conjunction with a positive pressure self-contained breathing apparatus (AAR, 1994; NFPA, 1994).

9.2 EYE/FACE PROTECTION

- A. Methylene chloride is an irritant; wear eye protection to prevent any reasonable probability of eye contact (NFPA, 1994; Sittig, 1991).

9.3 RESPIRATORY PROTECTION

- A. RESPIRATORY RECOMMENDATIONS - ERG2000 (HALOGENATED SOLVENTS) - GUIDE 160
 - 1. Wear positive pressure self-contained breathing apparatus (SCBA).
 - 2. Reference: ERG, 2000.
- B. Refer to "Recommendations for respirator selection" in the NIOSH Pocket Guide to Chemical Hazards on TOMES Plus(R) for respirator information.

9.4 PROTECTIVE CLOTHING

- A. INTRODUCTION
 - 1. All data are compiled from published sources and are NOT recommended specifically by Micromedex(R), Inc. The appearance of specific manufacturers or products in this section does not represent an endorsement by Micromedex(R), Inc. No attempt has been made to verify the data presented. All product recommendations should be confirmed with the specific manufacturer for verification of product performance.
 - 2. GENERAL
 - a. This section provides a compilation of chemical resistance information and test data for specific protective clothing products. Chemical resistance information includes both degradation resistance ratings and permeation resistance data. This information is designed to assist in the selection of appropriate protective clothing.
 - b. Only data on specific products and manufacturers are included. Generic information or recommendations are not provided since significant differences can exist in the chemical resistance for apparent similar product types.
 - c. Specific product information is organized by general product type (gloves, garments, and footwear), material type, and manufacturer. The category 'garments'

may include totally encapsulating suits, splash suits, as well as other items (e.g., coveralls, jackets, and aprons). Specific manufacturers should be contacted to determine the features of available styles/models.

- d. In addition to chemical resistance information, there are many critical variables in the selection of protective clothing which cannot be represented in this summary of the literature. Some factors to be considered in choosing protective clothing include, but are not limited to: overall clothing integrity, physical hazard resistance, durability, human factors, ease of decontamination, and cost. Overall clothing integrity refers to a specific design's ability to offer consistent protection for all clothing-covered areas of the body. Physical hazards include resisting the effects of abrasion, cuts, tears, and punctures. Human factors entail effects on wearer mobility, visibility, and hearing for garments; dexterity, tactility, and grip for gloves; ankle support and weight for footwear; and, any effect of the clothing on the function of the wearer. There are several variations in the design for gloves, garments, and footwear that affect these factors. Protective clothing must properly be sized and correctly fit the wearer to ensure its proper use and function.
- e. As required in the U.S.A., protective clothing should be selected based on a risk assessment of the workplace. This risk assessment must account for the identification of existing as well as potential hazards and involve the recommendation of protective clothing appropriate for the identified hazards. Therefore, the recommendations in this section should not be used as the sole basis for decisions on choice of protective clothing, but rather should be used as a tool by qualified occupational health and safety professionals or other technically qualified persons in conjunction with a review of all mitigating factors.
- f. Refer to the "PERSONAL PROTECTIVE EQUIPMENT - OSHA PUB 3077" INFOTEXT(R) Document for general information on protective clothing selection.

3. PROTECTIVE CLOTHING SELECTION

- a. Determine the type of protective clothing item needed based on a risk assessment (e.g., gloves, garments, footwear).
- b. For high risk situations, choose clothing that covers all parts of the body that may be exposed. In many cases, multiple clothing items will be required. Low risk situations may permit partial body protective clothing.
- c. Select protective clothing products that have reported chemical resistance data. High risk situations involving full body clothing or extended chemical contact often require permeation resistance data to determine the barrier effectiveness of materials used in the construction of clothing. Relatively low risk situations, where only splash or incidental exposure occur, may allow use of protective clothing based on degradation or penetration resistance data. Specifics on the interpretation of chemical resistance data are presented below.
- d. Other factors must be considered in addition to chemical resistance. The selected chemical protective clothing item should offer the optimal combination of protection against identified hazards while allowing maximum function and comfort.

4. INTERPRETATION OF DEGRADATION RATINGS

- a. Degradation refers to physical changes in a material as the result of chemical exposure. Degradation may become evident in visible changes, such as discoloration, swelling, delamination, deterioration, or disintegration. Degradation effects may also be measured by weight change or other changes in a material's physical properties (e.g., strength, elasticity, hardness).

- b. Degradation resistance ratings are provided by manufacturers to rate the amount of degradation that occurs for a particular protective clothing material when contacted by a chemical. All degradation ratings are qualitative and include ratings, such as "EXCELLENT," "GOOD," "FAIR," "POOR," and "NOT RECOMMENDED." There is no standard test method for the measurement of chemical degradation resistance; therefore, manufacturer ratings may be based on different testing approaches. This makes comparison of degradation ratings between manufacturers unreliable.
- c. The use of degradation resistance ratings alone to recommend protective clothing, particularly for high hazard situations, should be avoided. Degradation resistance testing does not directly assess the barrier quality of protective clothing, since materials can show relatively little degradation but still allow either permeation or penetration by a chemical. Degradation resistance ratings can be used to exclude protective clothing materials from consideration. Protective clothing materials with a "NOT RECOMMENDED" degradation resistance rating should never be used.
- d. For some products, the rating "NO PENETRATION" is provided. This refers to penetration resistance test results that are based on a different procedure (American Society for Testing and Materials (ASTM) Standard Test Method F 903). Penetration resistance testing involves placing a material sample in a test cell, exposing the exterior side of the material to a chemical, and then observing the interior side of the material for visible signs of liquid penetration. Part of the test is conducted at an elevated pressure. Test results are reported as pass (no penetration) or fail (penetration detected). Unlike degradation testing, penetration testing provides an assessment of protective clothing material barrier performance. Since penetration resistance testing examines only observable amounts of liquid penetration, permeation may still occur. The use of penetration resistance data must be restricted to liquid chemicals, and should be limited to scenarios where there is no reasonable vapor exposure hazard under the conditions of exposure.

5. INTERPRETATION OF PERMEATION DATA

- a. Permeation is the process of chemical movement through a material on a molecular level. Permeation resistance refers to the ability of a material to retard or prevent chemical movement through it. Permeation may occur without any visible signs of degradation.
- b. Permeation resistance is measured using a test cell which is divided into two halves by a protective clothing specimen. Chemical is placed on the challenge side, while the collection side is periodically monitored for permeating chemical. The permeation data provided in this section were obtained in accordance with the American Society for Testing and Materials (ASTM) Standard Test Method F 739 (Resistance of Materials Used in Protective Clothing to Permeation by Liquids and Gases).
- c. Permeation rate is the amount of chemical that passes through a material for a measured surface area per unit time. In this section, permeation rate is expressed in micrograms per square centimeter per minute (mcg/cm²/min). The reported permeation rate is either the steady-state rate or the maximum rate observed during testing. In some cases, very large permeation rates exceed measurement techniques and are reported as ">" (greater than) or "HIGH."
- d. Breakthrough time is the elapsed time, in minutes, from the time the chemical comes in contact with the material exterior surface, to the time that chemical is detected on the interior surface. When no breakthrough is detected, the

breakthrough time is report as ">" the testing period. If permeation breakthrough is rapid, results are reported as "<" (less than) the earlier sampling time or as "IMMEDIATELY" (which usually means breakthrough in less than 4 minutes).

- e. The breakthrough time should exceed the expected use period of the selected protective clothing. Additionally, there are several other factors that must be taken into account to provide appropriate protection.
 1. Permeation testing is usually conducted with full strength, undiluted chemical for the duration of the test period. Actual exposures may involve diluted chemical for short or intermittent exposure periods.
 2. Permeation testing is usually conducted at room temperature. Permeation occurs faster at elevated temperatures (short breakthrough times and higher permeation rates) and slower at reduced temperatures (long breakthrough times and lower permeation rates).
 3. Permeation resistance of mixtures cannot usually be determined on the basis of the individual chemicals making up the mixture. Synergistic effects may occur and result in more rapid permeation than accounted for by the individual mixture chemicals.
 4. Permeation rates may be used to calculate potential wearer exposure; however, several assumptions must be made about the extent of exposure and condition of clothing wear. Furthermore, there are few chemicals with dermal exposure limits, making it difficult to determine an acceptable skin exposure level.

B. GLOVES

1. BUTYL RUBBER Synonyms: IIR, Butyl

a. BEST MANUFACTURING

1. Best Butyl 878 (Best 1)

- Degradation Rating: FAIR
- 20 min Breakthrough Time
- 234 mcg/cm(2)/min Permeation Rate

b. GUARDIAN

1. CP-25, CP-14, and CP-7 (Guardian)

- No Degradation Rating provided
- 20 min Breakthrough Time
- >500 mcg/cm(2)/min Permeation Rate

2. IB-35 (Guardian)

- No Degradation Rating provided
- 20 min Breakthrough Time
- >500 mcg/cm(2)/min Permeation Rate

c. NORTH

1. B174 (North)

- Degradation Rating: POOR
- 24 min Breakthrough Time
- 133 mcg/cm(2)/min Permeation Rate

2. BUTYL RUBBER/NEOPRENE Synonyms/Description: Butyl Rubber laminated with

Neoprene

a. COMASEC SAFETY

1. Series 39 (Comasec)

- No Degradation Rating provided
- 12 min Breakthrough Time
- Permeation Rate not reported

3. NATURAL RUBBER Synonyms/Description: NR

a. ANSELL-EDMONT

1. Canners/Handlers 384 (Ansell-Edmont 1)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

2. Conform (Ansell-Edmont 2)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

b. BEST MANUFACTURING

1. Nitty Gritty 65NFW (Best 1)

- Degradation Rating: POOR
- Breakthrough Time not reported
- Permeation Rate not reported

c. BOSS MANUFACTURING

1. Not Specified (Boss)

- Degradation Rating: POOR
- Breakthrough Time not reported
- Permeation Rate not reported

d. COMASEC SAFETY

1. Series 12 (Comasec)

- No Degradation Rating provided
- 6 min Breakthrough Time
- 300 mcg/cm(2)/min Permeation Rate

2. Series 16 (Comasec)

- No Degradation Rating provided
- 18 min Breakthrough Time
- 152 mcg/cm(2)/min Permeation Rate

e. MARIGOLD INDUSTRIAL

1. Black Heavyweight 173 (Marigold)

- Degradation Rating: POOR
- 3 min Breakthrough Time
- >1000 mcg/cm(2)/min Permeation Rate

2. G04Y (Marigold)

- Degradation Rating: POOR
- 3 min Breakthrough Time
- >1000 mcg/cm(2)/min Permeation Rate

3. G12T (Marigold)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

4. Emperor ME104 (Marigold)

- Degradation Rating: POOR
- 8 min Breakthrough Time
- >1000 mcg/cm(2)/min Permeation Rate

5. 326Y (Marigold)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

6. Featherweight 414 (Marigold)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

7. Biogel P S965 (Marigold)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

f. MONTGOMERY SAFETY PRODUCTS

1. Natural Rubber (Montgomery)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

4. NATURAL RUBBER + NITRILE RUBBER Synonyms/Description: Natural Rubber blended with Nitrile Rubber

a. MARIGOLD INDUSTRIAL

1. Supasolve G28K (Marigold)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

5. NEOPRENE Synonyms/Description: Chloroprene Rubber; CR; NEO

a. ANSELL-EDMONT

1. Neoprene 29-840 (Ansell-Edmont 1)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

2. Neox 9-920 (Ansell-Edmont 1)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

b. BEST MANUFACTURING

1. Neoprene 6780 (Best 1)

- Degradation Rating: NOT RECOMMENDED
- 7 min Breakthrough Time
- 372 mcg/cm(2)/min Permeation Rate

2. Ultraflex Neoprene 32 (Best 1)

- Degradation Rating: NOT RECOMMENDED
- 3 min Breakthrough Time
- 162 mcg/cm(2)/min Permeation Rate

c. BOSS MANUFACTURING

1. Not Specified (Boss)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

d. COMASEC SAFETY

1. Series 36 (Comasec)

- No Degradation Rating provided
- 5 min Breakthrough Time
- 300 mcg/cm(2)/min Permeation Rate

e. MEMPHIS GLOVE

1. 6912 Series Neomax (Memphis)

- No Degradation Rating provided
- 5 min Breakthrough Time
- Permeation Rate not reported

f. MONTGOMERY SAFETY PRODUCTS

1. Neoprene (Montgomery)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

6. NEOPRENE/NATURAL RUBBER Synonyms/Description: Neoprene laminated with

Natural Rubber

a. ANSELL-EDMONT

1. Chemi-Pro 224 (Ansell-Edmont 1)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

7. NITRILE RUBBER Synonyms/Description: NBR; Nitrile

a. ANSELL-EDMONT

1. Sol-Knit 39-122 (Ansell-Edmont 1)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

2. Sol-Vex 37-145 (Ansell-Edmont 1)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

3. Touch-N-Tuff 92-500 (Ansell-Edmont 2)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

b. BEST MANUFACTURING

1. Nitri-Solve 727 (Best 1)

- Degradation Rating: NOT RECOMMENDED
- 4 min Breakthrough Time
- 249 mcg/cm(2)/min Permeation Rate

2. Ultraflex Nitrile 22R (Best 1)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

3. N-DEX 8005 (Best 2)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

4. N-DEX 6005 (Best 2)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

c. BIOSAFETY INDUSTRIAL PRODUCTS

1. Reliance (Biosafety)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

d. BOSS MANUFACTURING

1. Not Specified (Boss)

- Degradation Rating: FAIR
- Breakthrough Time not reported
- Permeation Rate not reported

e. MARIGOLD INDUSTRIAL

1. 368R (Marigold)

- Degradation Rating: POOR
- 9 min Breakthrough Time
- >1000 mcg/cm(2)/min Permeation Rate

2. Blue/green U263B/G (Marigold)

- Degradation Rating: POOR
- 3 min Breakthrough Time
- >1000 mcg/cm(2)/min Permeation Rate

3. Green Nitrile 315F (Marigold)

- Degradation Rating: POOR
- 2 min Breakthrough Time
- >1000 mcg/cm(2)/min Permeation Rate

f. MEMPHIS GLOVE

1. 9750 Series Predator (Memphis)

- No Degradation Rating provided
- 6 min Breakthrough Time
- Permeation Rate not reported

g. MONTGOMERY SAFETY PRODUCTS

1. M-Tech (Montgomery)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

h. NORTH

1. LA111EB (North)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

8. NITRILE RUBBER/LATEX Synonyms/Description: Nitrile Rubber laminated with Latex

a. MARIGOLD INDUSTRIAL

1. G43Y (Marigold)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

9. PLASTIC LAMINATE Synonyms/Description:

a. ANSELL-EDMONT

1. Barrier 2-100 (Ansell-Edmont 1)

- Degradation Rating: EXCELLENT
- 20 min Breakthrough Time
- <9.0 mcg/cm(2)/min Permeation Rate

b. NORTH

1. Silver Shield (North)

- Degradation Rating: GOOD
- >480 min Breakthrough Time
- <0.1 mcg/cm(2)/min Permeation Rate

c. SAFETY 4

1. 4H (Safety 4)

- No Degradation Rating provided
- >240 min Breakthrough Time
- <0.1 mcg/cm(2)/min Permeation Rate

10. POLYVINYL ALCOHOL Synonyms/Description: PVAL; PVA

a. ANSELL-EDMONT

1. PVA 15-552 (Ansell-Edmont 1)

- Degradation Rating: GOOD
- >360 min Breakthrough Time
- <0.9 mcg/cm(2)/min Permeation Rate

11. POLYVINYL CHLORIDE Synonyms/Description: PVC

a. ANSELL-EDMONT

1. Ever-Flex 13-102 (Ansell-Edmont 1)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

2. Dura-Touch (Ansell-Edmont 2)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

b. BEST MANUFACTURING

1. Hustler (Best 1)

- Degradation Rating: POOR

- Breakthrough Time not reported
- Permeation Rate not reported

c. BOSS MANUFACTURING

1. Not Specified (Boss)

- Degradation Rating: POOR
- Breakthrough Time not reported
- Permeation Rate not reported

d. COMASEC SAFETY

1. Series 22, 24 & 27 (Comasec)

- No Degradation Rating provided
- 6 min Breakthrough Time
- 583 mcg/cm(2)/min Permeation Rate

e. MEMPHIS GLOVE

1. 6400 Series Actifresh (Memphis)

- No Degradation Rating provided
- 8 min Breakthrough Time
- Permeation Rate not reported

12. POLYVINYL CHLORIDE/NITRILE RUBBER Synonyms/Description: Polyvinyl Chloride laminated with Nitrile Rubber; PVC/Nitrile

a. COMASEC SAFETY

1. Series 32 (Comasec)

- No Degradation Rating provided
- 12 min Breakthrough Time
- 443 mcg/cm(2)/min Permeation Rate

13. VITON(R) Synonyms/Description: Fluorocarbon Rubber; FPM; VIT

a. BEST MANUFACTURING

1. Best Viton 890 (Best 1)

- Degradation Rating: EXCELLENT
- 113 min Breakthrough Time
- 48 mcg/cm(2)/min Permeation Rate

b. NORTH

1. F101 (North)

- Degradation Rating: FAIR
- 60 min Breakthrough Time
- 7.3 mcg/cm(2)/min Permeation Rate

C. GARMENTS Includes encapsulating suits, splash suits, and other protective apparel.

1. BUTYL RUBBER Synonyms/Description: IIR, Butyl

a. KAPPLER

1. Butyl (Kappler)

- No Degradation Rating provided

- 4 min Breakthrough Time
- 583 mcg/cm(2)/min Permeation Rate

2. CHLORINATED POLYETHYLENE Synonyms/Description: CPE

a. ILC DOVER

1. Chemturon (Forsberg)

- No Degradation Rating provided
- 20 min Breakthrough Time
- Permeation Rate not reported

b. KAPPLER

1. Durables 2 (Kappler)

- No Degradation Rating provided
- 13 min Breakthrough Time
- 1418 mcg/cm(2)/min Permeation Rate

c. STANDARD SAFETY EQUIPMENT

1. ChemMaster (Forsberg)

- No Degradation Rating provided
- 6 min Breakthrough Time
- Permeation Rate not reported

3. NEOPRENE Synonyms/Description: Chloroprene Rubber; CR; NEO

a. RIVER CITY

1. Neoprene Splash Suits (River City)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

4. PLASTIC LAMINATE

a. DUPONT

1. Tyvek QC (Dupont)

- No Degradation Rating provided
- Breakthrough Time: Immediate
- Permeation Rate: High

2. Saranex/Tyvek (Dupont)

- No Degradation Rating provided
- Breakthrough Time: Immediate
- >50 mcg/cm(2)/min Permeation Rate

3. Tychem 7500 (Dupont)

- No Degradation Rating provided
- Breakthrough Time: Immediate
- 113 mcg/cm(2)/min Permeation Rate

4. Tychem 9400 (Dupont)

- No Degradation Rating provided
- 391 min Breakthrough Time
- 0.1 mcg/cm(2)/min Permeation Rate

5. Tychem 10,000 (Dupont)

- No Degradation Rating provided
- >480 min Breakthrough Time
- <0.1 mcg/cm(2)/min Permeation Rate

6. Barricade (Dupont)

- No Degradation Rating provided
- 391 min Breakthrough Time
- 0.1 mcg/cm(2)/min Permeation Rate

b. ILC DOVER

1. Ready 1 (ILC Dover)

- No Degradation Rating provided
- >480 min Breakthrough Time
- Permeation Rate not reported

c. KAPPLER

1. Frontline (Kappler)

- No Degradation Rating provided
- 391 min Breakthrough Time
- 0.1 mcg/cm(2)/min Permeation Rate

2. CPF1 (Kappler)

- No Degradation Rating provided
- <4 min Breakthrough Time
- >10 mcg/cm(2)/min Permeation Rate

3. CPF2 (Kappler)

- No Degradation Rating provided
- <4 min Breakthrough Time
- >10 mcg/cm(2)/min Permeation Rate

4. CPF3 (Kappler)

- No Degradation Rating provided
- 7 min Breakthrough Time
- >11 mcg/cm(2)/min Permeation Rate

5. CPF4 (Kappler)

- No Degradation Rating provided
- 114 min Breakthrough Time
- 2.4 mcg/cm(2)/min Permeation Rate

6. Responder (Kappler)

- No Degradation Rating provided
- >480 min Breakthrough Time
- <0.1 mcg/cm(2)/min Permeation Rate

7. Responder Plus (Kappler)

- No Degradation Rating provided
- >480 min Breakthrough Time
- <0.1 mcg/cm(2)/min Permeation Rate

8. Reflector (Kappler)

- No Degradation Rating provided
- >480 min Breakthrough Time
- <0.1 mcg/cm(2)/min Permeation Rate

d. KIMBERLY-CLARK

1. Hazard-Gard I (Kimberly-Clark)

- Degradation Rating: NO PENETRATION
- Breakthrough Time: Immediate
- Permeation Rate: High

2. Hazard-Gard II (Kimberly-Clark)

- Degradation Rating: NO PENETRATION
- 6 min Breakthrough Time
- Permeation Rate: High

e. STANDARD SAFETY EQUIPMENT

1. Mitigator (Standard Safety)

- No Degradation Rating provided
- >480 min Breakthrough Time
- <0.1 mcg/cm(2)/min Permeation Rate

f. TRELLEBORG-VIKING

1. TLU (Trelleborg-Viking)

- No Degradation Rating provided
- >480 min Breakthrough Time
- <0.1 mcg/cm(2)/min Permeation Rate

5. POLYVINYL CHLORIDE Synonyms/Description: PVC

a. KAPPLER

1. Durables 1 (Kappler)

- No Degradation Rating provided
- 4 min Breakthrough Time
- 425 mcg/cm(2)/min Permeation Rate

b. RIVER CITY**1. PVC Splash Suits (River City)**

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

c. STANDARD SAFETY EQUIPMENT**1. Greylite-20 (Standard Safety)**

- No Degradation Rating provided
- 4 min Breakthrough Time
- >400 mcg/cm(2)/min Permeation Rate

2. Winterglo-20 (Standard Safety)

- No Degradation Rating provided
- 4 min Breakthrough Time
- >400 mcg/cm(2)/min Permeation Rate

6. RUBBER LAMINATE**a. TRELLEBORG-VIKING****1. HPS (Trelleborg-Viking)**

- No Degradation Rating provided
- >480 min Breakthrough Time
- <0.1 mcg/cm(2)/min Permeation Rate

2. VPS (Trelleborg-Viking)

- No Degradation Rating provided
- >480 min Breakthrough Time
- <0.1 mcg/cm(2)/min Permeation Rate

7. TEFLON(TM) LAMINATE Synonyms/Description: Polytetrafluoroethylene; PTFE; TFE**a. CHEMFAB CORPORTATION****1. Challenge 5000 (Chemfab)**

- No Degradation Rating provided
- >180 min Breakthrough Time
- <0.1 mcg/cm(2)/min Permeation Rate

b. MAR-MAC MANUFACTURING**1. Commander Ultrapro (Mar-Mac)**

- No Degradation Rating provided
- >480 min Breakthrough Time
- <0.1 mcg/cm(2)/min Permeation Rate

D. FOOTWEAR**1. NEOPRENE Synonyms/Description: Chloroprene Rubber; CR; NEO****a. LACROSSE**

1. Not specified (LaCrosse-Rainfair)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

2. NITRILE RUBBER + POLYVINYL CHLORIDE Synonyms/Description: Nitrile Rubber blended with Polyvinyl Chloride; Nitrile/PVC

a. BATA SHOE COMPANY

1. Heartland (Bata)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

3. POLYURETHANE Synonyms/Description: PU

a. LACROSSE

1. Purolite (LaCrosse-Rainfair)

- No Degradation Rating provided
- <60 min Breakthrough Time
- Permeation Rate not reported

4. POLYURETHANE + POLYVINYL CHLORIDE Synonyms/Description: Polyurethane blended with Polyvinyl Chloride; Polyurethane/PVC

a. BATA SHOE COMPANY

1. Superpoly (Bata)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

2. Polyblend (Bata)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

b. LACROSSE

1. Not Specified (LaCrosse-Rainfair)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

5. POLYURETHANE BLEND Synonyms/Description: Blend of polyurethane with unspecified polymer

a. LACROSSE

1. Not specified (LaCrosse-Rainfair)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

6. POLYVINYL CHLORIDE Synonyms/Description: PVC**a. LACROSSE****1. Resistor (LaCrosse-Rainfair)**

- No Degradation Rating provided
- >60 min Breakthrough Time
- Permeation Rate not reported

2. Sureflex (LaCrosse-Rainfair)

- No Degradation Rating provided
- <60 min Breakthrough Time
- Permeation Rate not reported

3. Not Specified (LaCrosse-Rainfair)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

7. RUBBER BLEND**a. BATA SHOE COMPANY****1. Bluemax (Bata)**

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

2. Hazmax (Bata)

- No Degradation Rating provided
- >60 min Breakthrough Time
- <0.1 mcg/cm(2)/min Permeation Rate

3. Polymax (Bata)

- Degradation Rating: FAIR
- Breakthrough Time not reported
- Permeation Rate not reported

b. LACROSSE**1. Economy Short Boot (LaCrosse-Rainfair)**

- No Degradation Rating provided
- <60 min Breakthrough Time
- Permeation Rate not reported

2. Not Specified (LaCrosse-Rainfair)

- Degradation Rating: NOT RECOMMENDED
- Breakthrough Time not reported
- Permeation Rate not reported

c. SERVUS RUBBER

1. HZT (Servus 1)

- No Degradation Rating provided
- >60 min Breakthrough Time
- <0.1 mcg/cm(2)/min Permeation Rate

d. TINGLEY

1. HazProof (Tingley)

- No Degradation Rating provided
- >60 min Breakthrough Time
- <0.1 mcg/cm(2)/min Permeation Rate

E. REFERENCES

1. The data in this protective clothing section have been taken directly from manufacturers' product literature. A complete listing of consulted manufacturers and references is presented below. Every reference on this list may not be cited within each specific protective clothing section.

- a. Ansell-Edmont 1: SpecWare CD-ROM, 2nd Edition, 1300 Walnut Street, Box 6000, Coshocton, OH 43812 (800-800-0444).
- b. Ansell-Edmont 2: Protective Chemical Resistant Guide, 6th Edition, 1300 Walnut Street, Box 6000, Coshocton, OH 43812 (800-800-0444).
- c. Bata Shoe Company: Industrial Footwear Catalog, 4501 Pulaski Highway, Belcamp, MD 21017 (800-365-2282).
- d. Best Manufacturing 1: ChemRest Floppy Diskette, Edison Street, Menlo, GA 30731 (800-242-0323).
- e. Best Manufacturing 2: N-DEX Technical Guide, Edison Street, Menlo, GA 30731 (800-242-0323).
- f. Biosafety Industrial Products: Reliance Specifications, 10225 Willow Creek Road, San Diego, CA 92131 (800-421-6412).
- g. Boss Manufacturing Company: Work Gloves, 221 W. First Street, Kewanee, IL 61443 (800-447-4581).
- h. ChemFab Corporation: Chemical Permeation Guide Challenge Protective Clothing Fabrics, Daniel Webster Highway, P.O. Box 1137, Merrimack, NH 03054 (800-451-6101).
- i. Comasec Safety, Inc.: Product Literature, P.O. Box 1219, 8 Niblick Road, Enfield, CT 06082 (800-333-0219).
- j. Dupont: Permeation Guide for Dupont Tychem Fabrics (January 1996), P.O. Box 80705, Wilmington, DE 19880 (800-448-9835).
- k. Forsberg, K & Keith, LH: Chemical Protective Clothing: Permeation and Degradation Compendium, Lewis Publishers, Ann Arbor, MI, 1995.
- l. Guardian: Chemical Protection Product Literature, 302 Conwell Avenue, Willard, OH 44890 (800-243-7379).
- m. ILC Dover, Inc.: Ready 1 The Chemtursion Limited Use Chemical Protective Suit, P.O. Box 266, Frederica, DE 19946 (800-631-9567).
- n. Kappler, Inc.: Suit Smart Website, www.kappler.com, "chemical resistance", P.O. Box 218, Guntersville, AL 35976 (800-633-2410).
- o. Kimberly-Clark, Inc.: HAZARD-GARD Chemical Protection Apparel Chemical Resistance Information Guide, Away From Home Sector, P.O. Box 103001,

- Atlanta, GA 30076 (800-472-6881).
- p. LaCrosse-Rainfair: Safety Products, 3600 South Memorial Drive, Racine, WI 53403 (800-557-7246).
 - q. MAPA Pioneer: Pioneers in Hand Protection World-Class Industrial Gloves Product Literature, 512 East Tiffin Street, Willard, OH 44890 (800-537-2897).
 - r. Marigold Industrial: Industry In Safe Hands Product Literature, 3585 Engineering Drive, P.O. Box 926090, Norcross, GA 30092 (888-566-3468).
 - s. Mar-Mac Manufacturing, Inc.: Product Literature, P.O. Box 278, McBee, SC 29101 (800-845-6962).
 - t. Memphis Glove Company: Permeation Guide, P.O. Box 171814, Memphis, TN 38187 (800-955-6887).
 - u. Montgomery Safety Products: Montgomery Safety Products Chemical Resistant Glove Guide, 1117 Marion Avenue, SW, Canton, OH 44707 (800-562-0600).
 - v. Nat-Wear: Protective Clothing, 5 High Street, Miora, New York 12957 (800-833-7270).
 - w. Neese Industries, Inc.: Protective Wear Product Literature, P.O. Box 1059, Gonzales, LA 70707 (800-535-8042).
 - x. North: North Hand Protection IH-107, 2000 Plainfield Pike, Cranston, RI 02921 (800-430-4110).
 - y. Playtex: Fits Tough Jobs Like a Glove, 300 Nyala Farms Road, Westport, CT 06880.
 - z. River City: Protective Wear Product Literature, P.O. Box 171814, Memphis, TN 38187 (800-888-0347).
 - aa. Safety 4: Chemical Protection Guide, 9765 Widmer, Bldg. 5, Lenexa, KS 66215 (913-492-0860).
 - ab. Servus 1: Servus Rubber (NSP): Rock Island, IL 61202, Servus HZT, (800-777-9021).
 - ac. Servus 2: Servus - Ranger (NSP) Footwear Catalog, Rock Island, IL 61202 (800-777-9021).
 - ad. Standard Safety Equipment Company: Product Literature, 1407 Ridgeview Drive, McHenry, IL 60050 (708-359-1400).
 - ae. Stull, JO: Unpublished data (512-288-8272).
 - af. Tingley: Protective Footwear and Clothing for Industrial Applications, P.O. Box 100, South Plainfield, NJ 07080 (800-631-5498).
 - ag. Trelleborg-Viking, Inc.: Permeation Test Results for Trelchem Vapor-Protective Suits, 170 West Road, Portsmouth, NH 03801 (800-344-4458).
 - ah. Wells Lamont Industrial: Product Catalog, 7525 North Oak Park Avenue, Niles, IL 60714 (800-247-3295).
 - ai. Workrite: Chemical Splash Protective Garments, W.L. Gore Material Chemical Resistance Guide, 500 East Third Street, P.O. Box 1192, Oxnard, CA 93032 (800-521-1888)

9.5 ENGINEERING CONTROLS

- A. A facility for quickly drenching the body, or body parts, with water needs to be provided within the immediate work area. This is intended to quickly remove methylene chloride from any body areas likely to be exposed. In some instances a hose connected to a sink may be permissible, in others a full deluge shower may be required (NIOSH, 1998).

10.0 PHYSICAL HAZARDS

10.1 FIRE HAZARD

10.1.1 SUMMARY

A. FIRE OR EXPLOSION HAZARDS - ERG2000 (HALOGENATED SOLVENTS) - GUIDE 160

1. Some of these materials may burn, but none ignite readily.
2. Most vapors are heavier than air.
3. Air/vapor mixtures may explode when ignited.
4. Container may explode in heat of fire.
5. Reference: ERG, 2000.

B. PUBLIC SAFETY, GENERAL - ERG2000 (HALOGENATED SOLVENTS) - GUIDE 160

1. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number:
2. CANADA:
 - a. CANUTEC: 613-996-6666 (Collect calls are accepted); *666 cellular (in Canada only).
3. UNITED STATES:
 - a. CHEMTREC(R): 1-800-424-9300 (Toll-free in the U.S., Canada and the U.S. Virgin Islands); 703-527-3887 for calls originating elsewhere (Collect calls are accepted).
 - b. CHEM-TEL, INC.: 1-800-255-3924 (Toll-free in the U.S., Canada and the U.S. Virgin Islands); 813-248-0585 for calls originating elsewhere (Collect calls are accepted).
 - c. INFOTRAC: 1-800-535-5053 (Toll-free in the U.S., Canada and the U.S. Virgin Islands); 352-323-3500 for calls originating elsewhere (Collect calls are accepted).
 - d. 3E COMPANY: 1-800-451-8346 (Toll-free in the U.S., Canada and the U.S. Virgin Islands); 760-602-8703 for calls originating elsewhere (Collect calls are accepted).
 - e. MILITARY SHIPMENTS: 703-697-0218 - Explosives/ammunition incidents (Collect calls are accepted); 1-800-851-8061 - All other dangerous goods incidents.
4. MEXICO:
 - a. SETIQ: 01-800-00-214-00 in the Mexican Republic; For calls originating in Mexico City and the Metropolitan Area: 5559-1588; For calls originating elsewhere, call: 0-11-52-5-559-1588.
 - b. CECOM: 01-800-00-413-00 in the Mexican Republic; For calls originating in Mexico City and the Metropolitan Area: 5550-1496, 5550-1552, 5550-1485, or 5550-4885; For calls originating elsewhere, call: 0-11-52-5-550-1496, 0-11-52-5-550-1552, 0-11-52-5-550-1485, or 0-11-52-5-550-4885.
5. BRAZIL:
 - a. PRO-QUIMICA: 0-800-118270 (Toll-free in Brazil); 55-11-232-1144 for calls originating elsewhere (Collect calls are accepted).
6. For additional details see the section entitled "WHO TO CALL FOR ASSISTANCE" under the ERG Instructions.
7. Isolate spill or leak area immediately for at least 50 to 100 meters (160 to 330 feet) in all directions.
8. Keep unauthorized personnel away.
9. Stay upwind.

10. Keep out of low areas.
11. Reference: ERG, 2000.
- C. In air, methylene chloride vapor is not flammable by standard tests, or in conditions likely to be encountered, but will burn under extreme conditions (ACGIH, 1991; CHRIS, 1998).
- D. Although previously thought to be non-flammable except at elevated temperature or pressure or in oxygen-enriched air, methylene chloride vapor is, in fact, flammable in the range 12-19% in ambient air, given a sufficiently high level of ignition energy; ignition is difficult (Lewis, 1996; Urban, 1995).
- E. The available references disagree as to whether the liquid form of methylene chloride is flammable. It appears that it is "technically" flammable, but is unlikely to be so under most ambient conditions. This is what the literature states:
 1. It is a non-flammable solvent (liquid) (Ashford, 1994).
 2. This compound will not ordinarily burn or support combustion (OHM/TADS, 1998).
 3. The liquid does not easily burn (ATSDR, 1993).
 4. Methylene chloride is a combustible liquid (NIOSH, 1998).
- F. Toxic fumes of carbon monoxide, phosgene and hydrogen chloride are released when methylene chloride is heated to decomposition or when involved in combustion. Decomposition may occur after contact with open flame or hot surfaces (Lewis, 1996; NFPA, 1994).
- G. This compound will sink in water; this produces an irritating vapor (CHRIS, 1998).

10.1.6 FIRE CONTROL/EXTINGUISHING AGENTS

- A. SMALL FIRES - ERG2000 (HALOGENATED SOLVENTS) - GUIDE 160
 1. Dry chemical, CO2 or water spray.
 2. Reference: ERG, 2000.
- B. LARGE FIRES - ERG2000 (HALOGENATED SOLVENTS) - GUIDE 160
 1. Dry chemical, CO2, alcohol-resistant foam or water spray.
 2. Move containers from fire area if you can do it without risk.
 3. Dike fire control water for later disposal; do not scatter the material.
 4. Reference: ERG, 2000.
- C. FIRE INVOLVING TANKS OR CAR/TRAILER LOADS - ERG2000 (HALOGENATED SOLVENTS) - GUIDE 160
 1. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
 2. Cool containers with flooding quantities of water until well after fire is out.
 3. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
 4. ALWAYS stay away from tanks engulfed in fire.
 5. Reference: ERG, 2000.
- D. To fight a fire involving methylene chloride, carbon dioxide, dry chemical, foam, or water can be used. Large quantities of water spray can be employed to cool fire-exposed containers/structures. Apply water from as great a distance as is feasible (AAR, 1994; ITI, 1988; NFPA, 1994).

10.1.7 COMBUSTION TOXICITY

- A. Toxic combustion by-products include hydrogen chloride, phosgene, and carbon monoxide (HSDB, 1998; NFPA, 1994).

10.2 EXPLOSION HAZARD

A. FIRE OR EXPLOSION HAZARDS - ERG2000 (HALOGENATED SOLVENTS) - GUIDE 160

1. Some of these materials may burn, but none ignite readily.
2. Most vapors are heavier than air.
3. Air/vapor mixtures may explode when ignited.
4. Container may explode in heat of fire.
5. Reference: ERG, 2000.

B. PUBLIC SAFETY, GENERAL - ERG2000 (HALOGENATED SOLVENTS) - GUIDE 160

1. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed in the FIRE HAZARD section of this document.
2. Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions.
3. Keep unauthorized personnel away.
4. Stay upwind.
5. Many gases are heavier than air and will spread along ground and collect in low or confined areas (sewers, basements, tanks).
6. Keep out of low areas.
7. Ventilate closed spaces before entering.
8. Reference: ERG, 2000.

C. Methylene chloride vapor is not flammable/explosive by standard tests, or in conditions likely to be encountered, but will burn under extreme conditions (ACGIH, 1991).

D. Given the correct conditions, this compound forms flammable vapor-air mixtures in larger volumes and may be an explosion hazard in confined spaces, especially when exposed to heat or flame. Elevated temperature and pressure, an oxygen-enriched atmosphere, or contact with liquid oxygen are all conditions which will contribute to methylene chloride's potential for flammability/explosivity (Lewis, 1996; NFPA, 1994).

1. The vapor is flammable in the range 12-19% in ambient air, given a sufficiently high level of ignition energy (Lewis, 1996; Urben, 1995).

E. Mixtures in air with methanol vapor are flammable (Lewis, 1996; Urben, 1995).

F. It will also form explosive mixtures in combination with (Lewis, 1996; Urben, 1995):

Dimethyl sulfoxide + Perchloric acid
Dinitrogen pentoxide
Dinitrogen tetroxide
Nitric acid (concentrated)
Potassium
Quaternary ammonium azides (eg, sodium azide)
Sodium
Sodium-Potassium Alloy

G. See the REACTIVITY HAZARD Section for more information.

10.3 DUST/VAPOR HAZARD

A. PUBLIC SAFETY, GENERAL - ERG2000 (HALOGENATED SOLVENTS) - GUIDE 160

1. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed in the FIRE HAZARD section of this document.
2. Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions.

3. Keep unauthorized personnel away.
 4. Stay upwind.
 5. Many gases are heavier than air and will spread along ground and collect in low or confined areas (sewers, basements, tanks).
 6. Keep out of low areas.
 7. Ventilate closed spaces before entering.
 8. Reference: ERG, 2000.
- B. Poisonous fumes of phosgene and hydrogen chloride are released when methylene chloride is heated to decomposition or when involved in combustion. Decomposition may occur after contact with open flame or hot surfaces (Lewis, 1996; NFPA, 1994).

10.4 REACTIVITY HAZARD

- A. Methylene chloride is explosive in atmospheres with a high oxygen content (Lewis, 1996).
- B. Methylene chloride reacts violently with chemically active metals such as magnesium, potassium, sodium, titanium, as well as aluminum (and aluminum bromide) (Sittig, 1991; Pohanish, 1997; OHM/TADS, 2000; NFPA, 1997; Urben, 1995).
- C. When dry, it is noncorrosive at normal atmospheric temperatures to common metals such as iron, copper, etc. When in contact with water/moisture, especially at elevated temperatures, methylene chloride will corrode iron, some stainless steels, copper, nickel, and certain other metals (OHM/TADS, 2000).
- D. This compound reacts violently with (Lewis, 1996; Urben, 1995; Pohanish, 1997):
- Amines (such as 1,2-Diaminoethane)
 - Lithium
 - NaK
 - Nitric acid
 - Perchloric acid
 - Potassium-tert-butoxide
 - Potassium hydroxide + n-Methyl-n-nitrosourea
 - Strong caustics
 - Strong oxidizers
- E. Methylene chloride will attack some forms of plastic, rubber and coatings (Pohanish, 1997).
- F. A half-full separating funnel violently burst when shaken with methylene chloride and water (air was also present); a syringe used for DMSO and rinsed with methylene chloride exploded violently when filled with perchloric acid (Urben, 1995).
- G. When methylene chloride is prepared by the chlorination of methyl chloride, chloroform and carbon tetrachloride are produced (HSDB, 2000).
- H. When in contact with steel or metal chlorides at elevated temperatures (300-450 degrees C), the vapor tends to carbonize (HSDB, 2000).
- I. Carbon monoxide, formic acid, hydrochloric acid, methanol, and methyl chloride are formed after prolonged heating (180 degrees C) of a mixture of water and methylene chloride (HSDB, 2000).
- J. Toxic chloride fumes are emitted after exposure of methylene chloride to high temperatures (AAR, 1998). Phosgene is produced when methylene chloride is heated to decomposition (Lewis, 1996).
- K. Methylene chloride may accumulate static electricity charges; this may cause vapor ignition (Pohanish, 1997).
- L. See the EXPLOSION HAZARD Section for more information.

10.5 EVACUATION PROCEDURES

10.5.1 SUMMARY

- A. No specific Isolation - Protective Action Distances have been established for this substance.
- B. EVACUATION (LARGE SPILL) - ERG2000 (HALOGENATED SOLVENTS) - GUIDE 160
 - 1. Consider initial downwind evacuation for at least 100 meters (330 feet).
 - 2. Reference: ERG, 2000.
- C. EVACUATION (FIRE) - ERG2000 (HALOGENATED SOLVENTS) - GUIDE 160
 - 1. If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.
 - 2. Reference: ERG, 2000.
- D. PUBLIC SAFETY, GENERAL - ERG2000 (HALOGENATED SOLVENTS) - GUIDE 160
 - 1. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed in the FIRE HAZARD section of this document.
 - 2. Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions.
 - 3. Keep unauthorized personnel away.
 - 4. Stay upwind.
 - 5. Many gases are heavier than air and will spread along ground and collect in low or confined areas (sewers, basements, tanks).
 - 6. Keep out of low areas.
 - 7. Ventilate closed spaces before entering.
 - 8. Reference: ERG, 2000.

10.6 CONTAINMENT/DISPOSAL GUIDELINES

10.6.1 SUMMARY

- A. SPILL OR LEAK, GENERAL - ERG2000 (HALOGENATED SOLVENTS) - GUIDE 160
 - 1. ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area).
 - 2. Stop leak if you can do it without risk.
 - 3. Reference: ERG, 2000.
- B. Keep upwind to avoid breathing methylene chloride vapor. Stop the leak if this can be done without endangering anyone. Do not allow the material to enter sewers or water sources (AAR, 1994; NFPA, 1994).
- C. LAND SPILL (AAR, 1994; NFPA, 1994)
 - 1. Dig a holding area to contain spilled methylene chloride.
 - 2. Foamed concrete or polyurethane, sand bags, and soil can be used to dike the surface flow.
 - 3. Cement powder, commercial sorbents, and fly ash can be used to absorb large amounts of the liquid.
- D. WATER SPILL (AAR, 1994)
 - 1. To trap spilled methylene chloride at the bottom, use natural deep water pockets, excavated lagoons, or sand bag barriers.
 - 2. The trapped (undissolved) material can be removed with suction hoses. Peat or carbon can be used on the dissolved portion.
- E. AIR SPILL: Water mist/spray can be used to suppress vapors (AAR, 1994; NFPA, 1994).
- F. Methylene chloride, in concentrations of 1.2 mg/L or greater, is considered hazardous for land

disposal (Freeman, 1989).

10.6.2 SMALL LEAK/SPILL

- A. SMALL LIQUID SPILLS - ERG2000 (HALOGENATED SOLVENTS) - GUIDE 160
 - 1. Take up with sand, earth or other noncombustible absorbent material.
 - 2. Reference: ERG, 2000.
- B. At a safe distance from populated areas, small amounts of methylene chloride residue may be poured on ashes, dry sand, or earth and then allowed to evaporate (OHM/TADS, 1998).

10.6.3 LARGE LEAK/SPILL

- A. LARGE SPILLS - ERG2000 (HALOGENATED SOLVENTS) - GUIDE 160
 - 1. Dike far ahead of liquid spill for later disposal.
 - 2. Prevent entry into waterways, sewers, basements or confined areas.
 - 3. Reference: ERG, 2000.

10.6.4 DISPOSAL CONSIDERATIONS

10.6.4.4 PHYSICAL TREATMENT

- A. Methylene chloride is a potential candidate for various incineration methods (HSDB, 1998):
 - 1. Rotary kiln incineration (temperature range of 820-1600 degrees C) with a residence time of seconds for liquids and gases and hours for solids.
 - 2. Liquid injection incineration (temperature range of 650-1600 degrees C) with a residence time of 0.1-2 seconds.
 - 3. Fluidized bed incineration (temperature range of 450-980 degrees C) with a residence time of seconds for gases as well as liquids and longer for solids.
- B. Care must be taken if this compound is to be incinerated. Combustion must be complete to prevent the formation of phosgene. Additionally, an acid scrubber is needed to remove the halo acids which are produced (HSDB, 1998).
- C. Air stripping may be used to remove methylene chloride from water or aqueous waste streams (Freeman, 1989; HSDB, 1998).

11.0 ENVIRONMENTAL HAZARD MANAGEMENT

11.1 POLLUTION HAZARD

- A. Air emissions of large quantities of methylene chloride result from its use as an aerosol propellant, paint remover, metal degreaser and urethane foam blowing agent (ATSDR, 1993; Howard, 1990).
- B. Waste-water emissions result primarily from the following industries: paint and ink, aluminum forming, coal mining, photographic equipment and supplies, pharmaceutical, organic chemical/plastics, rubber processing, foundries and laundries (Howard, 1990).
- C. Methylene chloride is not known to occur naturally (ATSDR, 1993; Howard, 1990).

11.2 ENVIRONMENTAL FATE

11.2.1 AIR

- A. In the atmosphere, methylene chloride will degrade by reaction with photochemically produced hydroxyl radicals with a half-life of a few months. It will not be subject to direct photolysis. A small fraction of this compound will diffuse to the stratosphere where it will be rapidly degraded by reaction with chlorine radicals and photolysis. Some small amount may return to earth in rain (Howard, 1990).
- B. Half-life in air (Photo-oxidation half-life in air, based on rate data for the vapor-phase reaction with hydroxyl radicals) (Howard et al, 1991)

High: 4584 hours (191 days)
Low: 458 hours (approximately 19 days)

11.2.2 WATER

- A. This compound will be primarily lost by evaporation to the atmosphere. In natural waters, biodegradation is possible but will probably be quite slow when compared with the evaporation rate. There are few data on methylene chloride's adsorption to sediment. Under normal environmental conditions, hydrolysis and photolysis are not important processes. There are no data on photo-oxidation in water (Howard, 1990; Howard et al, 1991).
- B. Half-life in surface water (Based upon estimated unacclimated aqueous aerobic biodegradation half-life.) (Howard et al, 1991)

High: 672 hours (4 weeks)
Low: 168 hours (1 week)

- C. Half-life in ground water (Based upon estimated unacclimated aqueous aerobic biodegradation half-life.) (Howard et al, 1991)

High: 1344 hours (8 weeks)
Low: 336 hours (2 weeks)

- D. When released into a river, methylene chloride levels were undetectable 3 to 15 miles from the source (Howard, 1990).

11.2.3 SOIL

- A. Methylene chloride will quickly evaporate from surface soil and will partially leach into groundwater. Little is known about this compound's adsorptivity. Hydrolysis is not an important process under normal environmental conditions (Howard, 1990).
- B. Half-life in soil (Based upon estimated unacclimated aqueous aerobic biodegradation half-life.) (Howard et al, 1991)

High: 672 hours (4 weeks)
Low: 168 hours (1 week)

- C. The diffusive transport of methylene chloride was measured in air-dry soils to test the effect of non-linear sorption. The chemical followed the BET type sorption model. The increase of diffusivity with high initial chemical concentration produced higher-than-predicted emission rates (Shonnard et al, 1993).

11.5 BIODEGRADATION

- A. Methylene chloride was reported to be completely biodegraded under aerobic conditions with activated sludge or sewage seed between 6 hours to 7 days (Howard, 1990).
- B. Aerobic half-life (Based on unacclimated aerobic screening test data.) (Howard et al, 1991)

High: 672 hours (4 weeks)
Low: 168 hours (1 week)

- C. Anaerobic half-life (Based on unacclimated aerobic biodegradation half-life.) (Howard et al, 1991)

High: 2688 hours (16 weeks)
Low: 672 hours (4 weeks)

- D. Removal/secondary treatment: 94.5% (Based on the percent degraded under aerobic continuous flow conditions (Howard et al, 1991)

11.6 BIOACCUMULATION

11.6.7 BIOCONCENTRATION FACTOR

- A. With an estimated BCF of 5, methylene chloride is not expected to bioconcentrate in aquatic organisms (Howard, 1990).

11.7 ENVIRONMENTAL TOXICITY

- A. Ecotoxicity Values (HSDB, 1998; Verschueren, 1983):
 - 1. LC50, Pimephales promelas Rafinesque (fathead minnows), 193 mg/L/96 hour, flow-through bioassay
 - 2. LC50, Pimephales promelas Rafinesque (fathead minnows), 310 mg/L/96 hour, static bioassay
 - 3. LC50, Lepomis macrochirus (bluegill), 230 mg/L/24 hour, static bioassay
 - 4. LC50, Lepomis macrochirus (bluegill), 220 mg/L/96 hour at 21 to 23 degrees C, static bioassay
 - 5. LC50, Poecilia reticulata (guppies), 294 ppm/14 days, conditions of bioassay not specified
 - 6. LC50, Daphnia magna, 224,000 mcg/L/48 hour, conditions of bioassay not specified
 - 7. LC50, Mysid shrimp, 256,000 mcg/L/96 hour, conditions of bioassay not specified
 - 8. EC10, Pimephales promelas Rafinesque (fathead minnows), 68.5 mg/L/24 hour, flow-through bioassay
 - 9. EC10, Pimephales promelas Rafinesque (fathead minnows), 66.3 mg/L/48 hour, flow-through bioassay
 - 10. EC10, Pimephales promelas Rafinesque (fathead minnows), 66.3 mg/L/72 hour, flow-through bioassay
 - 11. EC10, Pimephales promelas Rafinesque (fathead minnows), 66.3 mg/L/98 hour, flow-through bioassay
 - 12. EC50, Pimephales promelas Rafinesque (fathead minnows), 99.0 mg/L/48 hour, flow-through bioassay
 - 13. EC50, Pimephales promelas Rafinesque (fathead minnows), 99.0 mg/L/72 hour, flow-through bioassay

14. EC50, Pimephales promelas Rafinesque (fathead minnows), 99.0 mg/L/96 hour, flow-through bioassay
15. EC90, Pimephales promelas Rafinesque (fathead minnows), 220.1 mg/L/24 hour, flow-through bioassay
16. EC90, Pimephales promelas Rafinesque (fathead minnows), 147.6 mg/L/48 hour, flow-through bioassay
17. EC90, Pimephales promelas Rafinesque (fathead minnows), 147.6 mg/L/72 hour, flow-through bioassay
18. EC90, Pimephales promelas Rafinesque (fathead minnows), 147.6 mg/L/96 hour, flow-through bioassay
19. LC10, Pimephales promelas Rafinesque (fathead minnows), 122.0 mg/L/24 hour, flow-through test bioassay
20. LC10, Pimephales promelas Rafinesque (fathead minnows), 94.0 mg/L/48 hour, flow-through test bioassay
21. LC10, Pimephales promelas Rafinesque (fathead minnows), 51.2 mg/L/96 hour, flow-through bioassay
22. LC10, Pimephales promelas Rafinesque (fathead minnows), 67.3 mg/L/72 hour, flow-through bioassay
23. LC50, Pimephales promelas Rafinesque (fathead minnows), 268.0 mg/L/24 hour, flow-through bioassay
24. LC50, Pimephales promelas Rafinesque (fathead minnows), 265.0 mg/L/48 hour, flow-through bioassay
25. LC50, Pimephales promelas Rafinesque (fathead minnows), 232.4 mg/L/72 hour, flow-through bioassay
26. LC90, Pimephales promelas Rafinesque (fathead minnows), 589.0 mg/L/72 hour, flow-through bioassay
27. LC90, Pimephales promelas Rafinesque (fathead minnows), 746.3 mg/L/48 hour, flow-through bioassay
28. LC90, Pimephales promelas Rafinesque (fathead minnows), 722.1 mg/L/96 hour, flow-through bioassay

12.0 PHYSICAL/CHEMICAL PROPERTIES

12.1 MOLECULAR WEIGHT

- A. 84.93

12.2 DESCRIPTION/PHYSICAL STATE

- A. Methylene chloride is a colorless, volatile (but not flammable in air) liquid with a sweet, penetrating, ether-like or chloroform-like odor (ACGIH, 1991; Lewis, 1996; AAR, 1998).

12.3 PH

- A. Not Applicable

12.4 VAPOR PRESSURE

- A. 349 mmHg (at 20 degrees C) (ACGIH, 1991; ATSDR, 1993; Verschueren, 1983)

- B. 350 mmHg (at 20 degrees C) (NFPA, 1994)
- C. 380 mmHg (at 22 degrees C) (Lewis, 1996)
- D. 434.9 mmHg (at 25 degrees C) (Howard, 1990)
- E. 440 mmHg (at 25 degrees C) (ACGIH, 1991; Clayton & Clayton, 1994)
- F. 500 mmHg (at 30 degrees C) (ATSDR, 1993; Verschueren, 1983)
- G. 58.2 kPa at 25 degrees C (Lide, 1995)

12.5 SPECIFIC GRAVITY

- A. LIQUID: 1.36174 (at 0/4 degrees C) (OTHER-TP) (Budavari, 1996)
- B. LIQUID: 1.33479 (at 15/4 degrees C) (OTHER-TP) (Budavari, 1996)
- C. LIQUID: 1.3255 (at 20/4 degrees C) (OTHER-TP) (Budavari, 1996)
- D. LIQUID: 1.30777 (at 30/4 degrees C) (OTHER-TP) (Budavari, 1996)
- E. LIQUID: 1.3 (NL-TP) (NFPA, 1997)
- F. LIQUID: 1.326 (at 20/4 degrees C) (OTHER-TP) (Lewis, 1996)
- G. 1.3266 (at 20 degrees C) (OTHER-TP) (ACGIH, 1991)
- H. KEY
 - 1. NL-TP: Not Listed, Temperature and Pressure
 - 2. NTP: Normal Temperature and Pressure (25 degrees C; 77 degrees F and 760 mmHg)
 - 3. OTHER-TP: Other, Temperature and Pressure
 - 4. STP: Standard Temperature and Pressure (0 degrees C; 32 degrees F and 760 mmHg)

12.6 DENSITY

- A. LIQUID: 1.34 kg/L (at 15 degrees C) (OTHER-TP) (Ashford, 1994)
- B. LIQUID: 1.3266 g/mL (at 20 degrees C) (OTHER-TP) (ATSDR, 1993; Lide, 1995)
- C. LIQUID: 1335.46 kg/m(3); 83.37 lb/ft(3) (at 20 degrees C) (OTHER-TP) (CGA, 1990)
- D. KEY
 - 1. NL-TP: Not Listed, Temperature and Pressure
 - 2. NTP: Normal Temperature and Pressure (25 degrees C; 77 degrees F and 760 mmHg)
 - 3. OTHER-TP: Other, Temperature and Pressure
 - 4. STP: Standard Temperature and Pressure (0 degrees C; 32 degrees F and 760 mmH)

12.7 FREEZING/MELTING POINT

- A. FREEZING POINT
 - 1. -98 degrees C (Ashford, 1994)
 - 2. -97 degrees C (Lewis, 1993)
 - 3. -96.72 degrees C; -142.1 degrees F (CGA, 1990)
 - 4. -96.7 degrees C; -142 degrees F; 176.5 degrees K (Lewis, 1996)
- B. MELTING POINT
 - 1. -97 degrees C; -142 degrees F (NFPA, 1994; Verschueren, 1983)
 - 2. -96.7 degrees C (Clayton & Clayton, 1994)
 - 3. -95.1 degrees C (ATSDR, 1993; ACGIH, 1991; Howard, 1990)
 - 4. -95 degrees C (Budavari, 1996; Lide, 1995)
 - 5. 178.01 degrees K (Lide, 1995)

12.8 BOILING POINT

- A. 39.75 degrees C (at 760 mmHg) (Budavari, 1996; Howard, 1990)

- B. 39.78 degrees C; 103.6 degrees F (CGA, 1990)
- C. 39.8 degrees C (Lewis, 1996)
- D. 39-40 degrees C (Ashford, 1994)
- E. 40 degrees C (at 76 mmHg) (ACGIH, 1991; Lide, 1995)
- F. 40 degrees C; 104 degrees F (ATSDR, 1993; NFPA, 1994)
- G. 40.1 degrees C (Clayton & Clayton, 1994; Lewis, 1993)
- H. 40-42 degrees C (Verschuere, 1983)
- I. 313 degrees K (at 1 atmosphere) (Lide, 1995)

12.9 FLASH POINT

- A. Methylene chloride has no flash point in air or in a conventional closed tester, but it forms flammable vapor-air mixtures in larger volumes (Clayton & Clayton, 1994; Lewis, 1993; NFPA, 1994).

12.10 AUTOIGNITION TEMPERATURE

- A. 556 degrees C; 1033 degrees F (Lide, 1995; NFPA, 1994)
- B. 632 degrees C; 1170 degrees F (NFPA, 1994)
- C. 662 degrees C; 1224 degrees F (ATSDR, 1993; Lewis, 1993)
- D. 1139 degrees F (Lewis, 1996)

12.11 EXPLOSIVE LIMITS

12.11.1 LOWER

- A. 8.1% (NFPA, 1994)
- B. 12% (at 25 degrees C; 77 degrees F) (CGA, 1990; Sittig, 1991)
- C. 13% (Lide, 1995; NFPA, 1994)
- D. 15.5% (in oxygen) (Clayton & Clayton, 1994; Lewis, 1996)

12.11.2 UPPER

- A. 17.4% (NFPA, 1994)
- B. 19% (Sittig, 1991)
- C. 22% (at 25 degrees C; 77 degrees F) (CGA, 1990)
- D. 23% (Lide, 1995; NFPA, 1994)
- E. 66.4% (in oxygen) (Clayton & Clayton, 1994; Lewis, 1996)

12.12 SOLUBILITY

A. SOLUBILITY IN WATER

- 1. Methylene chloride is slightly soluble in water (ACGIH, 1991).
 - a. It is about 1-1.2 percent soluble by weight at room temperature (ACGIH, 1991).
 - b. 2 g/100 ml (at 25 degrees C) (Clayton & Clayton, 1994)
 - c. 13,000 mg/L (at 25 degrees C) (Howard, 1990)
 - d. 16,700 mg/L (at 25 degrees C) (Verschuere, 1983)
 - e. 20,000 mg/L (at 20 degrees C) (Verschuere, 1983)

B. SOLUBILITY IN SOLVENTS

1. Methylene chloride is soluble in alcohol, ether, ethanol, ethyl ether and acetone (Lewis, 1997; Clayton & Clayton, 1994).
2. It is miscible with acetone, alcohol, carbon tetrachloride, chloroform, ether, dimethylformamide, and with most organic solvents (ACGIH, 1991; Budavari, 1996; Lewis, 1996).
3. It is also miscible with chlorinated and oxygenated solvents (Ashford, 1994).

12.13 REACTIVITY

12.13.2 HAZARDOUS REACTIONS

- A. Methylene chloride is explosive in atmospheres with a high oxygen content (Lewis, 1996).
- B. Methylene chloride reacts violently with chemically active metals such as magnesium, potassium, sodium, titanium, as well as aluminum (and aluminum bromide) (Sittig, 1991; Pohanish, 1997; OHM/TADS, 2000; NFPA, 1997; Urben, 1995).
- C. When dry, it is noncorrosive at normal atmospheric temperatures to common metals such as iron, copper, etc. When in contact with water/moisture, especially at elevated temperatures, methylene chloride will corrode iron, some stainless steels, copper, nickel, and certain other metals (OHM/TADS, 2000).
- D. This compound reacts violently with (Lewis, 1996; Urben, 1995; Pohanish, 1997):

Amines (such as 1,2-Diaminoethane)
Lithium
NaK
Nitric acid
Perchloric acid
Potassium-tert-butoxide
Potassium hydroxide + n-Methyl-n-nitrosourea
Strong caustics
Strong oxidizers

- E. Methylene chloride will attack some forms of plastic, rubber and coatings (Pohanish, 1997).
- F. A half-full separating funnel violently burst when shaken with methylene chloride and water (air was also present); a syringe used for DMSO and rinsed with methylene chloride exploded violently when filled with perchloric acid (Urben, 1995).
- G. When methylene chloride is prepared by the chlorination of methyl chloride, chloroform and carbon tetrachloride are produced (HSDB, 2000).
- H. When in contact with steel or metal chlorides at elevated temperatures (300-450 degrees C), the vapor tends to carbonize (HSDB, 2000).
- I. Carbon monoxide, formic acid, hydrochloric acid, methanol, and methyl chloride are formed after prolonged heating (180 degrees C) of a mixture of water and methylene chloride (HSDB, 2000).
- J. Toxic chloride fumes are emitted after exposure of methylene chloride to high temperatures (AAR, 1998). Phosgene is produced when methylene chloride is heated to decomposition (Lewis, 1996).
- K. Methylene chloride may accumulate static electricity charges; this may cause vapor ignition (Pohanish, 1997).
- L. See the EXPLOSION HAZARD Section for more information.

12.16 OCTANOL/WATER PARTITION COEFFICIENT

- A. $\log = 1.25$ (Howard, 1990)

B. $\log = 1.3$ (ATSDR, 1993)

12.17 HENRY'S CONSTANT

- A. 2.68×10^{-3} atm-m(3)/mol (Howard, 1990)
- B. 2.03×10^{-3} atm-m(3)/mol (ATSDR, 1993)
- C. 3.19×10^{-3} atm-m(3)/mol (Ehrenfeld et al, 1986)

12.19 OTHER/PHYSICAL

- A. BULK LIQUID DENSITY
 - 1. 11.07 lb/gal (at 20 degrees C) (Lewis, 1997)
 - 2. 83.37 lb/ft(3) (at 20 degrees C; 68 degrees F) (CGA, 1990)
 - 3. 1335.46 kg/m(3) (at 20 degrees C; 68 degrees F) (CGA, 1990)
- B. CRITICAL PRESSURE: 6.10 MPa (Lide, 1995)
- C. CRITICAL TEMPERATURE
 - 1. 510 Kelvin (Lide, 1995)
- D. ELECTRIC DIPOLE MOMENT (GAS): 1.6 debye units (Lide, 1995)
- E. ENTHALPY OF FORMATION (GAS): -95.6 kJ/mol (at 298.15 Kelvin) (Lide, 1995)
- F. ENTHALPY OF FORMATION (LIQUID): -124.1 kJ/mol (at 298.15 Kelvin) (Lide, 1995)
- G. EVAPORATION RATE (ETHER = 100): 62 (CGA, 1990)
- H. HEAT CAPACITY: 51.0 J/mol (at 298.15 Kelvin) (Lide, 1995)
- I. HEAT OF FUSION: 6.0 kJ/mol (at -95.14 degrees C) (Lide, 1995)
- J. HEAT OF VAPORIZATION
 - 1. 141.7 Btu/lb (at the boiling point) (CGA, 1990)
 - 2. 28.06 kJ/mol (at 40 degrees C) (Lide, 1995)
 - 3. 28.82 kJ/mol (at 25 degrees C) (Lide, 1995)
 - 4. 142 Btu/lb; 78.7 cal/g; 3.30×10^5 J/kg (CHRIS, 2000)
- K. INDEX OF REFRACTION: 1.4244 (at 20 degrees C) (Budavari, 1996; Lewis, 1997)
- L. KAURI-BUTANOL NUMBER: 136 (at 25 degrees C; 77 degrees F) (CGA, 1990)
 - 1. "The higher the Kauri-Butanol number, the greater the dissolving power for certain gums." (CGA, 1990)
- M. ODOR THRESHOLD
 - 1. The threshold ranges from 25 to 150 ppm; 100 ppm is not easily detectable by most people, and above 300 ppm most people detect the odor. This means that odor is a poor indicator of possibly dangerous air concentrations of methylene chloride (the TLV is 50 ppm) (ACGIH, 1991; Sittig, 1991).
 - 2. 160-620 ppm; 540-2160 mg/m(3) (in air) (ATSDR, 1993)
 - 3. 9.1 ppm (in water) (ATSDR, 1993)
 - 4. 205-307 ppm (CHRIS, 2000)
 - 5. 25-50 ppm (OHM/TADS, 2000)
 - 6. 214 ppm (recognition in air) (HSDB, 2000)
 - 7. low = 540 mg/m(3); high = 2,160 mg/m(3) (HSDB, 2000)
- N. SPECIFIC HEAT CAPACITY: 1.19 J/g K (at 25 degrees C) (Lide, 1995)
- O. VAPOR DENSITY (AIR = 1): 2.9 (NFPA, 1997)
- P. VISCOSITY: 0.430 cP (at 20 degrees C) (Lewis, 1997)
- Q. IONIZATION POTENTIAL: 11.32 eV (NIOSH, 2000)
- R. CRITICAL PRESSURE: 895 psia; 60.9 atm; 6.17 MN/m(2) (CHRIS, 2000)
- S. CRITICAL TEMPERATURE: 245 degrees C; 473 degrees F; 518 Kelvin (CHRIS, 2000)
- T. CRITICAL DENSITY: 472 kg/m(3) (HSDB, 2000)

- U. HEAT OF FUSION: 16.89 cal/g (CHRIS, 2000)
- V. RATIO OF SPECIFIC HEATS OF VAPOR (GAS): 1.199 (CHRIS, 2000)
- W. SPECIFIC HEAT (HSDB, 2000):

14.24 cal/K/mol (at 400 Kelvin)
17.30 cal/K/mol (at 600 Kelvin)
19.32 cal/K/mol (at 800 Kelvin)
20.76 cal/K/mol (at 1000 Kelvin)

- X. HEAT OF MELTING: 1.1 kcal/mol (at the boiling point) (HSDB, 2000)
- Y. HEAT OF SUBLIMATION: 6.94 kcal/mol (at 298 Kelvin) (HSDB, 2000)
- Z. HEAT CAPACITY
 - 1. 12.16 cal/degree/mol (gas) (HSDB, 2000)
 - 2. 54.09 J/mol (at 25 degrees C) (HSDB, 2000)
- AA. SURFACE TENSION: 28.12 dyne/cm (at 20 degrees C) (HSDB, 2000)
- AB. THERMAL CAPACITY: 1.171 kJ/kg.K (at 15-45 degrees C) (HSDB, 2000)
- AC. ENTHALPY OF FORMATION (GAS): -22.80 kcal/mol (HSDB, 2000)
- AD. ENTHALPY OF FORMATION (LIQUID): -29.80 kcal/mol (HSDB, 2000)
- AE. GIBBS FREE ENERGY OF FORMATION (GAS): -16.46 kcal/mol (HSDB, 2000)
- AF. GIBBS FREE ENERGY OF FORMATION (LIQUID): -16.83 kcal/mol (HSDB, 2000)
- AG. DIELECTRIC STRENGTH: 94.488 (24.000) V/cm (at 24 degrees C) (HSDB, 2000)
- AH. SPECIFIC RESISTIVITY: 1.81×10^8 ohm/cm (HSDB, 2000)

13.0 SAMPLING AND ANALYTICAL METHODS

13.1 ENVIRONMENTAL MONITORING

- A. DOE Method OC010R(a) (Draft Method, Revision 2, October 1994) is used in the preparation and cleanup of hydrocarbon containing samples for the analysis of volatile organic compounds (Chemsoft, 1996).
- B. DOE Method OP030R(a) (Revision 2, October 1994) analyzes volatile compounds from radioactive samples using gas chromatography or mass spectrometry. The method is a modification of EPA's SW-846 Method 5030 (Purge and Trap) for use in a glovebox (Chemsoft, 1996).
- C. EPA Method 601 (July 1991) is used in the determination of 29 purgeable halocarbons through purge and trap gas chromatography (Chemsoft, 1996).
- D. EPA Method 624 (July 1991) is used in the determination of a number of purgeable organics through purge and trap gas chromatography/mass spectrometry (Chemsoft, 1996).
- E. EPA Method 624 Contract Laboratory Program (CLP) (Modified for CLP, OLM 1.8, August 1991) is a gas chromatography/mass spectrometry method used in the analysis of volatile compounds from water, sediment, and soil from hazardous waste sites (Chemsoft, 1996).
- F. EPA Method 624 Contract Laboratory Program (CLP) (Modified for CLP, OLM 2.1, December 8, 1993) is a purge and trap gas chromatography/mass spectrometry method for analysis of volatiles from water, sediment and soil from hazardous waste sites (Chemsoft, 1996).
- G. EPA Method 624 Contract Laboratory Program (CLP) (Revision for CLP, OLM 3.1., August 1994) is a purge and trap gas chromatography/mass spectrometry method used in the analysis of volatile compounds from water, sediment, and soil from hazardous waste sites (Chemsoft, 1996).
- H. EPA Method 5032 (SW-846 Proposed Update III, Revision 0, January 1995) is a vacuum distillation method used to determine volatile organic compounds in a variety of liquid, solid,

solid waste matrices and animal tissues (Chemsoft, 1996).

- I. EPA Method 8010 (SW-846 Third Edition, September 1986) is a gas chromatography method used for the detection of halogenated volatile organic compounds (Chemsoft, 1996).
- J. EPA Method 8010A (SW-846 Update I, July 1992) is a gas chromatography method used to determine the concentration of various halogenated organic compounds (Chemsoft, 1996).
- K. EPA Method 8010B (SW-846 Update II, September 1994) is a gas chromatographic method used for the detection of halogenated volatile organic compounds (Chemsoft, 1996).

13.2 AIR

- A. EPA Method 0031 (SW-846 Proposed Update III, Revision 0, January 1995) is used in the measurement of volatile organic compounds from gaseous emissions from a wide variety of stationary sources including hazardous waste incinerators (Chemsoft, 1996).
- B. EPA Method 0040 (SW-846 Proposed Update III, Revision 0, January 1995) is a method designed to standardize the sampling of principal organic hazardous constituents from combustion sources using Tedlar(R) Bags (Chemsoft, 1996).
- C. EPA Method 5041 (SW-846 Update II, September 1994) is used in the analysis of volatile principal organic hazardous constituents collected from the stack gas effluents of hazardous waste incinerators using the volatile organic sampling train (VOST) wide-bore capillary column technique (Chemsoft, 1996).
- D. EPA Method 5041A (SW-846 Proposed Update III, Revision I, January 1995) is used in the analysis for desorption of sorbent cartridges from volatile organic sampling train (VOST) using capillary gas chromatography/mass spectrometry technique (Chemsoft, 1996).
- E. EPA Method IP-1A (Revised, September 30, 1989) is used in the determination of volatile organic compounds in indoor air using stainless steel canisters (Chemsoft, 1996).
- F. EPA Method TO2 (Revision 1.0, April 1984) is a method used for the determination of volatile organic compounds in ambient air by carbon molecular sieve adsorption and gas chromatography/mass spectrometry (Chemsoft, 1996).
- G. EPA Method TO14 (Revision 1.0, June 1987) is used in the determination of volatile organic compounds in ambient air using SUMMA(r) passivated canister sampling and gas chromatographic analysis (Chemsoft, 1996).
- H. OSHA Method 07 (Issue November 1979, Last update November 1989) is a method using charcoal (petroleum based) adsorption tubes and desorption with an organic solvent. Samples are analyzed by gas chromatography with a flame ionization detector (Chemsoft, 1996).

13.3 WATER

- A. EPA Method 502.1 (Revision 2.0, 1989) is a purge and trap gas chromatography method applicable for the determination of various halogenated volatile compounds in finished drinking water, raw source water, or drinking water in all treatment stages (Chemsoft, 1996).
- B. EPA Method 502.2 (Revision 2.0, 1989) is a general purpose method for testing volatile organic compounds in finished drinking water, raw source water, or drinking water by purge and trap capillary column gas chromatography with photoionization and electrolytic conductivity detectors in series (Chemsoft, 1996).
- C. EPA Method 502.2 (Supplement III, Revision 2.1, August, 1995) is used for the identification and simultaneous measurement of volatile organic compounds in water by purge and trap capillary column gas chromatography with photoionization and electrolytic conductivity detectors in series (Chemsoft, 1996).
- D. EPA Method 524.1 (Revision 3.0, 1989) is a general purpose method for the measurement of purgeable organic compounds in water by packed column gas chromatography/mass

spectrometry (Chemsoft, 1996).

- E. EPA Method 524.2 (Supplement II, August 1992) is used in the measurement of purgeable organic compounds in water by capillary column gas chromatography/mass spectrometry (Chemsoft, 1996).
- F. EPA Method 524.2 (Supplement III, Revision 4.1, August, 1995) is used for the identification and simultaneous measurement of purgeable organic compounds in water by capillary column gas chromatography/mass spectrometry (Chemsoft, 1996).

13.4 SOIL

- A. EPA Method 5021 (SW-846 Update III, Revision 0, January 1995) is a gas chromatography/mass spectrometry method used for the preparation of volatile organic compounds in soils/sediments and solid wastes using equilibrium headspace analysis (Chemsoft, 1996).
- B. EPA Method 8021 (SW-846 Update I, July 1992) is a capillary technique gas chromatography method which utilizes electrolytic conductivity and photoionization detectors in series to determine halogenated and aromatic volatile compounds in a variety of solid waste matrices (Chemsoft, 1996).
- C. EPA Method 8021A (SW-846 Update II, September 1994) is a capillary technique gas chromatographic method using photoionization and electrolytic conductivity detectors in series for the detection of halogenated volatiles in a variety of solid waste matrices (Chemsoft, 1996).
- D. EPA Method 8021B (SW-846 Proposed Update III, Revision 2, January 1995) is a capillary column gas chromatography method which utilizes photoionization and electrolytic conductivity detectors in series to determine volatile organic compounds in a variety of solid waste matrices (Chemsoft, 1996).
- E. EPA Method 8240 (SW-846 Third edition, September 1986) is a gas chromatography/mass spectrometry method used in the analysis of volatile organics in a variety of matrices (Chemsoft, 1996).
- F. EPA Method 8240A (SW-846 Update I, July 1992) is a gas chromatography/mass spectrometry method used to determine volatile organic compounds in a variety of solid waste matrices (Chemsoft, 1996).
- G. EPA Method 8240B (SW-846 Update II, September 1994) is a gas chromatography/mass spectrometry method used to determine volatile organic compounds in a variety of solid waste matrices (Chemsoft, 1996).
- H. EPA Method 8260 (SW-846 Update I, July 1992) is a gas chromatography/mass spectrometry method using capillary column techniques to determine volatile organic compounds in a variety of solid waste matrices (Chemsoft, 1996).
- I. EPA Method 8260A (SW-846 Update II, September 1994) is a gas chromatography/mass spectrometry method used to determine volatile organic compounds in a variety of solid waste matrices (Chemsoft, 1996).
- J. EPA Method 8260B (SW-846 Proposed Update III, Revision 2, January 1995) is a gas chromatography/mass spectrometry capillary column technique to determine volatile organic compounds in a variety of solid waste matrices (Chemsoft, 1996).

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14.4 HOTLINES/INFORMATION RESOURCES

A. CHEMTREC

1. The above information is generic for the compound. For further product specific information, consult manufacturer. In an emergency, contact CHEMTREC at 1-800-424-9300 or 703-527-3887 if outside the continental U.S.
2. Immediately notify the National Response Center (1-800-424-8802) if a release of a reportable quantity of a hazardous substance to the environment has occurred.

B. EPA ENVIRONMENTAL RESPONSE TEAM

1. In case of a large spill or release, notify appropriate local pollution, fire, and emergency response authorities. Seek 24-hour professional environmental engineering assistance through the EPA's Environmental Response Team (ERT), Edison, New Jersey (201) 321-6660.

C. NATIONAL PESTICIDE TELECOMMUNICATIONS NETWORK

1. Provides consultation to poison centers and other health professionals for the management of pesticide poisoning. Calls will be transferred to the Oregon Poison Center in Portland, Oregon for all emergency cases requiring immediate medical response. The National Pesticide Telecommunications Network has a toll-free number, 1-800-858-7378, or if outside the U.S., the non-toll-free number is 541-737-6094. Hours are 6:30 to 4:40 PM PST Monday-Friday.

15.0 AUTHOR INFORMATION

15.1 CONTRIBUTOR(S) TO THIS DOCUMENT

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- D. The Protective Clothing section of this document was updated with relevant manufacturers' product data by Jeffrey O. Stull, MS: 06/99
- E. Specialty Board: Hazard

